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Nebraska's Resources and Industries 1920

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THE NEBRASKA CONSERVATION AND WELFARE COMMISSION

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Following the enactment of the Civil Administrative Code Bill for Nebraska, the work of the Conservation and Welfare Commission passed to the Conservation and Soil Survey and the State Department of Agriculture.

THE NEBRASKA CONSERVATION AND SOIL SURVEY

This department, under the Regents of The University of Nebraska, surveys the resources and industries of the state; investigates conservation problems; passes upon foreign realty sold in Nebraska; serves as a state information bureau, and publishes reports which are free upon request.

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NEBRASKA
RESOURCES AND INDUSTRIES

By

S. R. McKELVIE, Governor of Nebraska, Chairman of the Conservation and Welfare Commission and

G. E. CONDRA, Director, Conservation and Soil Survey; Executive Secretary, Conservation and Welfare Commission.

Introductory—This little volume recites facts regarding Nebraska's resources and industries. It is published to meet the needs of an inquiring public, yet the subjects covered are those on which every Nebraskan should have full and intimate knowledge.

Data in this report have been secured from dependable sources. Most of the information has been supplied by persons engaged in state surveys, departments of The University of Nebraska and State Administration. The purpose is to set forth a number of fundamental facts in as brief space as is possible and in a manner that will insure their usefulness to the reader. There is no over-boosting.

This bulletin is the second of its kind published by the State. The first, Nebraska Facts, by Will M. Maupin, was issued by the Conservation and Welfare Commission.

Use of Index—Persons wishing to refer at once to a subject in this report should consult the index, note the page reference, and turn to the discussion. This will save time.

Signed Articles—Our report consists of signed articles by persons engaged in technical studies of Nebraska resources and the development of these resources. The authors are responsible for their statements, all of which have been verified.

Order of Treatment—It has seemed best to introduce in this report with the theme—resources and industries—a brief discussion of the conditions which influence state development. One of these controlling factors or conditions is the climate of the state. *

The subject matter of this bulletin is grouped under the following heads:

1. Soil Resources and Regions
2. Climate of Nebraska
3. Mineral Resources and Industries
4. Water Resources
5. Wild Life Resources
6. Agricultural Nebraska
7. Manufactures
8. Transportation, Communication, and Markets
9. Education in Nebraska
10. Nebraska Facts

Federal and State Reports—Many useful reports have been issued on Nebraska's resources and industries. Most of them are free upon request. Among the departments from which published information can be secured are the United States Geological Survey, U. S. Bureau of Soils, U. S. Weather Bureau, U. S. Department of Agriculture; the Nebraska Conservation and Soil Survey, and the Agricultural Experiment Station of The University of Nebraska. Various departments of the State Administration publish free reports on such subjects as irrigation, roads, health, fish, game, and foods.

Information Bureau—The Nebraska Conservation and Soil Survey of The University of Nebraska serves as an information bureau regarding the state's resources, industries and development. Information supplied from this source is based on surveys and special investigations.

Motion Pictures and Lantern Slides—The Conservation and Soil Survey in charge of the state's photographic work, has many lantern slides and about 100,000 feet of motion picture film covering Nebraska's resources and industries. Colored slides are being prepared on a large number of subjects for general distribution. The motion picture films cover such subjects as irrigation, dry farming, cattle raising, beet sugar, breeds of hogs, apple raising, fish and game, state institutions, The University of Nebraska, State Fair, the potash industry, water power, the butter industry, and journeys in Nebraska. They are distributed in Nebraska and other states without charge, except the express. Persons wishing the use of slides or film should write the Nebraska Conservation and Soil Survey at The University of Nebraska, Lincoln.

Resources and Development—The state is richly endowed with those resources and conditions which further agricultural, social and economic development. The state occupies an advanced condition of development and does not seek to further immigration in order to increase the population at the expense of other commonwealths or for the purpose of swelling the count. Nebraska stands for that development of the resources which makes the citizenship efficient, and happy to be good Americans.

* Frances Daly, Edith Anderson, E. A. Thomas, Frank Shoemaker and A. E. Andersen of the Conservation and Soil Survey have rendered valuable assistance in the preparation of this bulletin.

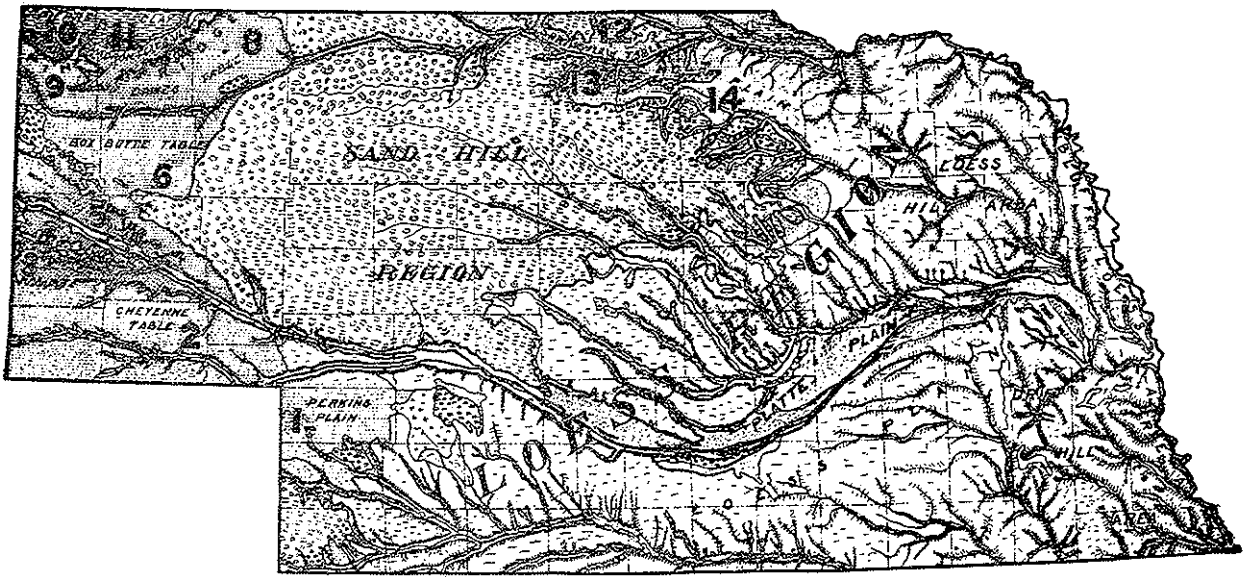


Figure 1. Map showing the Soil Regions of Nebraska. Numbers 1 to 14 represent the divisions of the High Plains Region. The divisions are 1, Perkins Plain; 2, Cheyenne Table; 3, Pumpkin Creek Valley; 4, Wildcat Ridge; 5, North Platte Valley; 6, Box Butte Table; 7, Niobrara Valley; 8, Dawes Table; 9, Pine Ridge; 10, Hat Creek Basin; 11, White River Basin; 12, Springview Table; 13, Ainsworth Table; 14, Holt Plain.

THE SOIL RESOURCES AND REGIONS OF NEBRASKA

By G. E. CONDRA,
Director, Nebraska Conservation and Soil Survey

Nebraska is large and diverse. The area is 77,510 square miles. The altitude ranges between about 840 feet in the southeastern corner of Richardson County and 5,340 in the western part of Banner County. Surface features vary from smooth plains to mountainous areas.* There are more than 100 soils which constitute the state's most important resource. Persons wishing a fuller or more extended discussion of soil resources of the state should secure soil bulletin 15 of the Conservation and Soil Survey.

On a basis of soil and topography, Nebraska has three well defined regions—the Loess, Sandhill, and High Plains. These have the subdivisions shown by figure 1.

LOESS REGION

This region, so named on account of its subsoil, occupies about 42,000 square miles, or more than the southeast half of the state. It is a well-developed agricultural region.

The loess is well shown in many railroad cuts and excavations as at Omaha, Plattsmouth, and Nebraska City. There are three kinds known as the plains, terrace, and bluff loesses. The deposits occur throughout the uplands of the Loess Region, except on the drift hills.

The loess is generally, but erroneously, known as "yellow clay." Technically, it is mostly silt, containing some clay and fine sand. It is a silt loam. The most distinguishing features are the buff color, massive appearance, fine texture, and ability to stand vertically in bluffs and exposures. Loess forms the most even-textured, deep, fertile subsoil of our country.

The Loess Region has eight kinds of land, known as loess plains, loess hills, drift hills, bluff lands, canyon areas, bench lands, flood plains or bottom lands proper, and small areas of wind-formed hills.

Loess Plains, or the nearly level uplands of the region, have an area of about 14,100 square miles (Figure 2). The largest and most typical plain is between Gosper and Saunders counties. Its boundaries are the Platte, Republican, and Big Blue valleys. The surface of this plain is quite even, but modified to some extent by small drainage-ways, shallow basins, and low knolls. Some of the typical locations on this plain are David City, Fairmont and Holdrege.

* See Geography of Nebraska, published by the University Publishing Company, Lincoln, Nebr.

Smaller loess plains are located north of Ogallala, south of the Platte Valley at Sutherland, in southwestern Lincoln County, southeastern Chase County, northeastern Dundy, southern Frontier, southwestern and southeastern Custer, part of the upland between Broken Bow and Sargent, northern Buffalo, small areas north of Ravenna, six miles south of North Loup, the upland between St. Paul and Boelus, west of Wolbach, southwest of Spalding, and the nearly flat uplands of Boone, Madison, Wayne, Cuming, Dodge, Douglas, Washington, and other northeastern counties. Several loess plains occur east of the Big Blue, as in eastern Seward, northern Gage, southern Lancaster, central Cass and eastern Johnson counties.

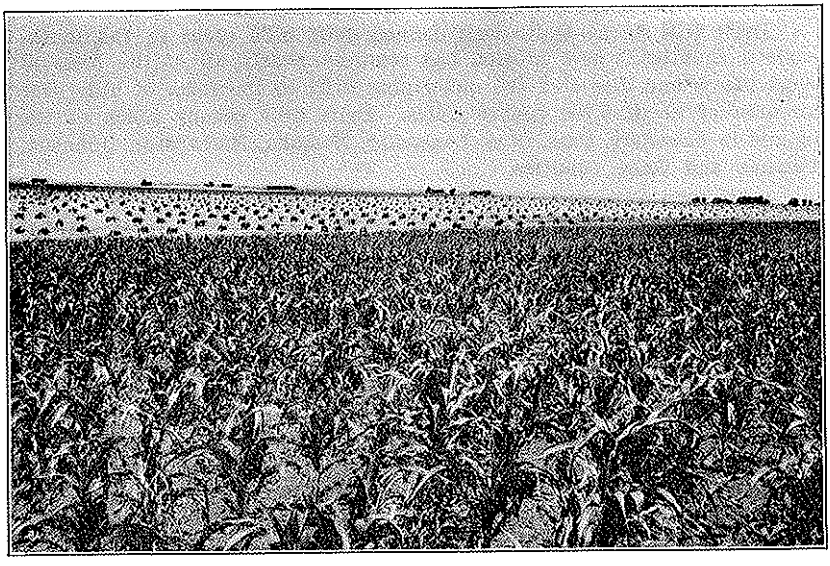


Figure 2. View of Loess Plain, Fillmore County, showing the large fields of corn and wheat which occur in that part of Nebraska.

All of the above plains are capped with 25 to 100 feet of loess subsoil. The land is stone free and very easy to till. The main crops are wheat, oats, alfalfa, and corn. The country is most beautiful. There are endless views of improved farms and towns. Land values range between $100 and $500 per acre depending on the position, amount of rainfall, and improvements. For further information in regard to the loess plains consult the soil surveys of Fillmore, Dodge and Phelps counties.

Loess Hill Areas—These, with an area of about 11,900 square miles, occupy the northeastern counties of the state and a narrow strip

just west of the bluff belt of the Missouri farther south. The hilly areas are characterized by a thick loess subsoil which forms a remarkably smooth surface. Deep in most of the hills are sand, drift, and bedrock. These materials outcrop at places and are encountered in wells and some wagon and railroad cuts.

There are several kinds of soil in the loess hill areas. The *Marshall silt loam* is the main type. Its upper soil is dark brown to nearly black, 10 to 15 inches thick, and comparatively mellow. The *Marshall* absorbs moisture quite readily and does not wash much. Nearly all of this soil is in successful cultivation. Country and towns are well developed. For detailed information in regard to the loess hill soils consult the surveys of Douglas, Dodge, Wayne and Washington counties.

Drift Hill Area—Quite well defined drift hills occur in the southeastern counties, where erosion has removed nearly all of the loess at most places and dissected the underlying drift to the form of hills over an area of about 6,700 square miles. Drift hills occupy much of the upland in Saunders, Cass, Otoe, Lancaster, Nemaha, Richardson, Johnson, Pawnee and Gage counties.

Drift hills average smaller and less smooth than loess hills. They are easily recognized by the form and by the presence of gravel, pebbles and boulders which may be exposed in the soils and uncovered in such places as banks, cuts, and wells.

Two soils—the *Carrington silt loam* and the *Shelby loam*—occupy much of the area. The silt loam is dark in its upper part, but changes below this finely weathered zone, which carries considerable humus, to a slightly compact upper division of the subsoil and then to the drift containing clay, silt, sand, concretions and boulders. This soil has more clay and sand and less silt than the *Marshall silt loam* of the loess hill areas. The *Shelby loam* occurs on many knolls, sharp crests and steep hillsides of the drift hills. It represents an eroded phase of the silt loam but contains less organic matter, due to erosion, and shows stony materials. Sandy soils occur on some hillsides. The bottom or alluvial lands, having principally the *Wabash silt loam* are unusually fertile.

Much of the drift hill area is in a high state of cultivation. Corn, alfalfa, wheat, and oats are the main crops. Land values range between $125 and $475 an acre. Persons wishing further information about the drift hill area should consult the soil survey reports of Richardson, Nemaha, Cass, and Saunders counties.

Bluff Lands border the Missouri, Platte, Republican and other valleys but grade into the hilly and smooth uplands without a distinct line of division. The approximate area of this type of land in the Loess Region is about 1,000 square miles.

Some of the river bluffs are quite high, as along the Missouri. From the top downward they contain loess, drift, and bedrock. The mantle rock materials dislodge from the steep slopes making land slides below and vertical walls above. The bluff land belts are cut by many deep ravines and small valleys and further modified by numerous ridges and spurs. As a whole, the topography is rough. The principal soil is the *Knox silt loam.*

The *Knox silt loam* resembles the *Marshall silt loam* in the lower subsoil but has less humus in the upper layer. It has a thin surface soil on account of low humus content. A noticeable feature of the *Knox silt loam* is its ability to stand in cuts and grades. It is mellow and can be plowed at any depth in the subsoil where exposed.

The *Knox silt loam* is well suited to growing grass, trees and fruit. Apples and grapes are grown commercially. Alfalfa does well even on steep slopes. See the soil surveys of Douglas and Nemaha counties.

Canyon Areas—These have a combined area of about 1,500 square miles in the western part of the Loess Region. Here the rough, steep sided valleys, called canyons, separate the upland into flats. Canyon areas occur in parts of Lincoln, Hayes, Frontier, Hitchcock, Gosper, Dawson, and Custer counties. Small slips or land slides are common in canyons having sides not so steep, and in places the flat divides have been eroded away leaving areas of bold hills separated by V-shaped canyons.

The soils of canyon areas are classed as the rough phase of the *Colby* series. The color is light gray. There is less humus than in other soils derived from loess and the texture ranges between silt and fine sand. Coarser materials occur in most of the floors or bottoms of the canyons. These were washed from sand layers under the loess.

Much of the soil of the canyon areas is used for grazing. The small, flat divides are farmed to wheat, oats, rye, corn, kafir, cane, etc.

Benches or Terraces are a feature in the valleys of the Loess Region. They are remnants of old flood plains. The total area of the bench land in this region is about 2,150 square miles.

Some of the best defined terraces are at Blair, Omaha, Nemaha City, Ashland, Wahoo, Lincoln, Lyons, Fullerton, St. Paul, north of Fremont, Schuyler, and Columbus, and at Oxford, McCook, and Culbertson. They occur in two or three levels at most of these places.

Most terraces are capped with silt loam. The leading soil is the *Waukesha silt loam* which is dark brown, 12 to 15 inches deep, and high in organic matter. It has a smooth velvety feel. The subsoil is a yellowish silty clay which at about 20 inches becomes very compact and grades into a yellow color. The subsoil becomes loess-like below 30 to 40 inches.

The *Waukesha* soils occupy most of the benches in the central and eastern counties, but are modified by small patches of basin soils of heavier texture and knolls having soils of lighter texture.

Sand is exposed along the edges of some terraces. This sand mixes with the silt from above or washes out upon the valley floor making fine sandy loams. Persons wishing descriptions of the bench land soils should consult the surveys of Saunders, Dodge, Douglas, Wayne and other counties.

The bench lands of Nebraska have high value because of their fertility and freedom from overflows. They are well suited to grain farming and especially well adapted to alfalfa raising.

Bottom or Alluvial Lands are well defined in all river valleys and in most creek valleys of the Loess Region. The total area of such land, including flood plains, alluvial fans, colluvial slopes, and the poorly defined, low benches, is about 3,750 square miles.

Several alluvial soils have been mapped. Among them are those of the *Wabash*, *Cass*, *Sarpy*, *Hall*, *Lamoure*, and *Judson* series. Descriptions of these series may be found in the soil surveys of Washington, Nemaha, Richardson, Douglas, Wayne, Dodge, Gage, Polk, Fillmore, Hall, Phelps, and other counties.

The *Wabash silt loam*, *silty clay loam*, and *clay* are common alluvial soils in the eastern part of the region. They are close textured, dark colored and unusually deep as shown on the flood plains of the Big Nemaha, Little Nemaha, Weeping Water, Salt Creek, Maple Creek, and Logan Creek, and most of the Big Blue and its tributaries. There are considerable areas of these soils in the Platte, Elkhorn, and Missouri River valleys. As a whole, the *Wabash* soils are very fertile. They are generally farmed to corn rotated with small grain. Drainage is required at places.

The *Cass* series, represented by five types, is black in the surface layer, brownish to grayish in the upper subsoil and underlain by a thick layer of sand. These soils are productive.

The *Lamoure* soils, represented by three types mapped along the Platte in Dodge, Polk, Hall, and Phelps counties, resemble those of the *Wabash* series, but are less perfectly drained. They have a calcareous subsoil, which is lighter in color than that of the *Wabash* series.

The *Judson silt loam* occurs as small areas principally on colluvial slopes at the foot of uplands and terraces in various parts of Dodge, Hall, Polk and Phelps counties and is not subject to flooding. It is deep, dark brown and contains considerable humus.

There are a number of other alluvial soils in the principal valleys of the Loess Region. As a rule, they become more sandy and carry less

humus as one goes westward. The sandy soils are well suited to grazing and hay production and those of finer textures are well adapted to farming.

Wind-formed Areas occur at various places along the western border of the Loess Region and at a few places on the loess plains proper. They are represented by choppy hills resembling dunes and occupy about 900 square miles.

In a general way, the larger wind-formed areas are a broader land between the loess and sandhill regions. Their soils vary in texture but are composed largely of sand and silt. The largest areas of these soils are north and northeast of Minden; east of Hildreth; north of Grand Island; in western Boone County; eastern Wheeler County; northwest of Greeley; northeastern Lincoln County; on the upland south of North Platte; 10 miles southwest of Maywood, and at the east border of the sandhills in Dundy County. The land is used for grazing, production of native hay and for farming.

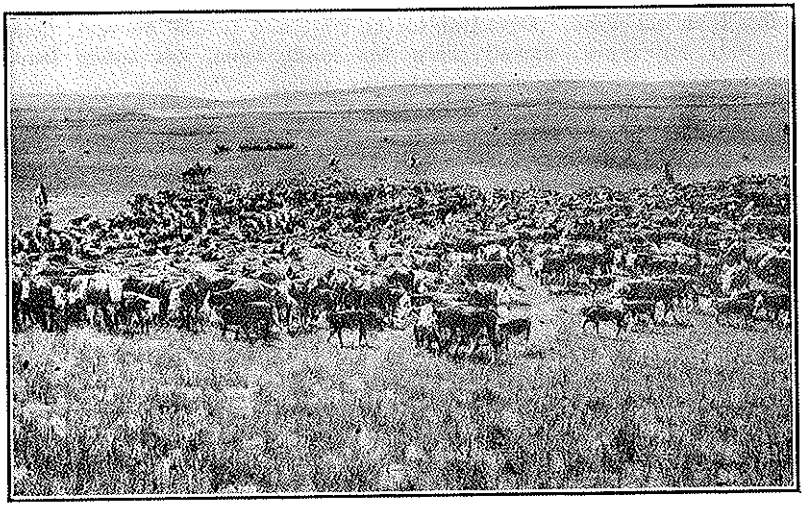


Figure 3. Fifteen hundred well-bred cows and calves on a ranch in the Sandhill Region, Cherry County, Nebraska.

SANDHILL REGION

This is the best defined soil region in Nebraska. The topography, drainage, soils and roads are very unlike those of the Loess Region to the east and the high plains on the west.

The main body of the sandhills, in the north-central and central-western parts of the state, is known as the Sandhill Region. There are

several outlying areas, making in all about 20,000 square miles, occupied by hills, basins, valleys, marshes, and lakes.

The soils of the sandhill areas are quite sandy as a rule. They correlate with the land forms and are herein described as *dunesand, dry valley* soils, and *wet valley* soils.

Dunesand is the typical soil of the sandhills. It occupies about two-thirds of the area of the region and is characterized by its mobility, low humus content, and uniform fine sandy texture. There is little difference between surface soil and subsoil. Both are light gray in color and of loose structure. They contain a very low percentage of silt and clay. The hill land, valued at from $8 to $20 an acre, is used nearly wholly for grazing (Figure 3).

The State Survey classifies the hills under two divisions—first grade and second grade, depending upon the continuity of the grass cover and the amount of blow ground.

Dry Valley Soils occur on the basins and dry valleys. They are more stable than *dunesand*. According to the state and federal surveys, there are four soil types; namely, *very fine sandy loam, fine sandy loam, loamy sand*, and *sand of* the *Valentine* series. The *very fine sandy loam* and the *fine sandy loam* are quite stable, having fairly well defined surface soils. They do not blow badly and are farmed at a number of places. The lighter soils blow where not protected. Land values range between $20 and $60 an acre.

Wet Valley Soils are on the poorly drained valleys. The largest areas are in Cherry County, northeastern Morrill, northern Garden, southern Sheridan, and southern Rock County. Two wet valley soils, the *fine sandy loam* and the *loamy fine sand*, have been mapped and classed with the *Gannett* series. They are composed principally of the finer grades of sand, but contain small amounts of clay and some humus. Small areas of the *Gannett* soils contain alkali.

The wet land grades into marshy areas, which occur mostly on the seepage sides of lakes. Some of the valleys are nearly wholly occupied by marsh land which contains considerable organic matter. The vegetation of the marshes is unlike that of the wet meadows and very different from the covering on the hills. The wet meadow soils are used mainly for native hay production. Land values range between $25 and $60 an acre.

HIGH PLAINS REGION

This, the most diverse part of Nebraska, occupies a little more than 15,000 square miles of table land, rough broken areas, and valleys. It has three names—the Table Land Region, Western Region, and the High

Plains. The most distinctive feature is the high plains, hence, the name now used. The smooth uplands are used for farming and grazing. Much of the valley land is irrigated.

The largest natural divisions of the High Plains Region are Perkins Plains, 1,650 square miles; Cheyenne Table, 3,275; Pumpkin Creek Valley, 455; Wildcat Ridge, 151; North Platte Valley, 1,100; Box Butte Table, 2,010; Niobrara Valley, 240 (western part); Dawes Table, 1,400; Pine Ridge, 500; Hat Creek Basin, 390; White River Basin, 862; Springview Table, 642; Ainsworth Table, 284, and Holt Plain, 1,400.

Perkins Plain is in Perkins, Chase, and Keith counties and northeastern Colorado, but has its most typical development in the northeastern part of Perkins County, Nebraska. It is bordered on the north by South Platte Valley, and on the east and south by sandhill and loess areas. The surface varies from nearly level to rough and is modified by a few sandhills. (See Chase County Soil Survey.)

The soils of Perkins Plain are residual and aeolian. Three leading series are represented, namely, the *Rosebud*, *Dawes*, and *Valentine*. The *Rosebud* types are grayish to brown, deep to shallow, and underlain by sand or bedrock. Four types are represented, the *silt loam*, *loam*, *very fine sandy loam*, and *sandy loam*. The *Dawes* soils (resembling the Dunlap) have a heavy upper subsoil. The most typical development is in the vicinity of Lamar. The *Valentine* soils, represented by five types, are lighter than those of *Rosebud* and *Dawes*. They show less difference between the soil and subsoil and have a tendency to blow when plowed.

The soils of Perkins Plain are used for grazing and farming The more sandy types, because of blowing, are devoted to grazing. Dry farming is practiced generally on the more stable soils. Wheat, rye, oats, kafir, corn, etc., are the main crops. Land values range between $15 and more than $100 an acre.

Cheyenne Table is bordered on the north by the Pumpkin Creek and North Platte valleys and extends southward to and beyond Lodgepole Creek and the Colorado line. Much of the surface is a smooth table land, but some of it is undulating to rolling and rough. The eastern part, a spur between the Platte valleys, is capped with loess. The rest of the area, except on the valley floors, has residual soils.

The leading soil series on the table land is the *Rosebud*, represented by five types ranging between the *silt loam* and the *gravelly sandy loam*. The Kimball County survey classes these soils with the Sidney series, a name which has been discontinued. (See Cheyenne County Soil Survey.)

The *Rosebud* soils are comparatively deep, depending upon the

topographic position whether on slopes or smooth uplands. The nearly level parts of the table are modified by basins lined with a heavy soil known as the *Scott silt loam.*

Some of the steep slopes of Cheyenne Table have stony outcrops. The slopes, as along the Lodgepole, have sandy soils classed with the *Cheyenne* series. Similar materials occur in many sand draws. Finer textured soils of the *Tripp* series occur on the low terraces, principally in Lodgepole Valley. The bottom land soils proper of the valley are classed with the *Laurel* series. They have a light to pale yellow surface layer and a coarse, calcareous subsoil. Persons wishing a description of Cheyenne Table should secure the soil reports of Kimball, Cheyenne, and Morrill counties.

Certain soils in Cheyenne Table have been farmed successfully for a number of years, as in the vicinity of Dalton. The drouthy soils are best suited to grazing. Here, as elsewhere, the farmer should select a farm on a basis of the soils and climate.

Land values for Cheyenne Table range between $35 and $150 an acre. Wheat, oats, corn, cane, and potatoes are the principal crops. There is successful irrigation on higher priced land in Lodgepole Valley.

Pumpkin Creek Valley, between Cheyenne Table and Wildcat Ridge, is tributary to the North Platte Valley. It is bordered by escarpment-like walls throughout most of its course, but is open near the Wyoming line and at the point of junction with the Platte.

Long slopes are a feature of the valley floor. These are of two kinds, those formed by the weathering and erosion of the underlying Brule clay, and those built up of colluvial materials. The Brule clay slopes are rounded and billowy. They are eroded as small badlands at places. The colluvial slopes, occurring south of the creek in the eastern part of the valley, are comparatively smooth and terrace-like. The bottom lands of the valley consist of the flood plains bordering Pumpkin Creek and its tributaries, and of low terraces.

There are a number of soils in Pumpkin Creek Valley. Those with largest distribution are classed with the *Epping*, *Bridgeport*, *Tripp*, and *Laurel* series. The *Epping silt loam* was developed upon the Brule clay. It grades within a few inches from the yellowish-brown surface soil to the undisturbed Brule clay. The soils on the colluvial slopes are classed with the *Bridgeport* series represented principally by fine sandy loam and very fine sandy loam, but there are small areas of fine sand. These soils drain well and are easily worked, but are subject to blowing where light textured.

The *Tripp* soils occur on the benches, and range between the very fine sandy loam and fine sand. The drainage is good and most of the

soil is suited for farming. The *Laurel* soils occur on the first bottoms of the trunk and tributary streams.

The soils of Pumpkin Creek Valley are described in the Survey reports of Scotts Bluff, Banner and Morrill counties and in the Reconnoissance Soil Survey of Western Nebraska, which may be secured from the U. S. Bureau of Soils, Washington. The absence of a railroad in the valley has retarded development. The rough and sandy lands are grazed but much of the rest of the area is dry farmed and irrigated. Land values range between $10 and about $125 an acre.

Wildcat Ridge is between Pumpkin Creek and North Platte valleys. It begins near the eastern end of 66-Mountain at the Wyoming line and extends eastward and southeastward about 50 miles, ending in Court House and Jail Rock south of Bridgeport. It rises from 400 to 700 feet above the bordering valleys in most of its course, but lowers eastward. Three prominent spurs project northward and northeastward toward the Platte ending in Scottsbluff Mountain, Castle Rock, and Chimney Rock. A spur extending southward ends in Hog Back Mountain and Wildcat Mountain. Among the features of Wildcat Ridge are Signal Butte, altitude 4,583 feet; Bald Peak, 4,420 feet; Scottsbluff Mountain, 4,662 feet; Hog Back Mountain, 5,082 feet; and Court House Rock, 4,100 feet. Wildcat Ridge is scenic because of its relief, topography, and pine forest.

Much of Wildcat Ridge is rough broken land thinly covered with grass, shrubs, and pines. The less abrupt parts are occupied by the *Rosebud stony fine sand* and the more gradual slopes by the *Rosebud loamy fine sand.* Most of the soil is used for grazing. Some is farmed.

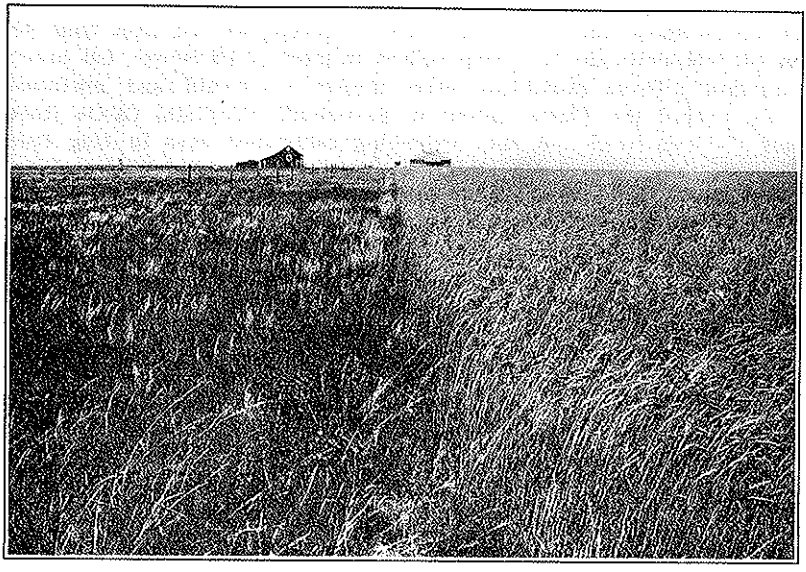
North Platte Valley is Nebraska's most important irrigation country. The soils, topography, climate, and water supply support irrigation on a large scale.

The valley is wide between the Wyoming line and the eastern part of Morrill County, beyond which it is narrow to the point of union with the South Platte. The upper parts of the valley sides are steep, stony land. Sandhills border the north side between Oshkosh and North Platte. The rough stony land on the south gives way below Lewellen to loess bluffs. One feature of the valley is a large terrace on the north between the Wyoming line and northwest of Bridgeport. A long, bench-like colluvial slope forms the south side of most of the valley in Scotts Bluff and Morrill counties. The flood plain proper has a considerable area of silt loam to sandy and gravelly soils, part of which is poorly drained.

There are several soils in the North Platte Valley, varying from silt loam to the nearly barren slopes of the rough broken land. The soils with largest distribution are classed with the *Epping, Mitchell,*

Bridgeport, Tripp, Laurel, and *Minatare* series, which are described in the soil surveys of Scotts Bluff and Morrill counties. Much of the agricultural land is farmed under irrigation and valued at $150 to $500 an acre. There is intensive farming of the best land. Among the main crops are beets, alfalfa, wheat, oats, rye, corn, and potatoes. Vegetables and fruit of several kinds are grown. There are a number of good towns and cities in the valley served by the Burlington and Union Pacific railroads.

Box Butte Table is between the North Platte and Niobrara valleys and bordered on the east by the Sandhill Region. The surface of the table ranges from nearly flat to undulating, rolling and rough, and



Firgure 4. View on Box Butte Table showing a big crop of wheat alongside the original prairie.

is modified at places by small sandhill areas. The borders near the Platte and Niobrara are roughened by numerous ravines and canyons.

The soils of Box Butte Table are classed with the *Rosebud, Dunlap, Yale, Tripp, Laurel,* and *Valentine* series. The *Rosebud* and *Dunlap* soils are similar to those of Cheyenne Table. (See soil survey of Box Butte County).

The *Rosebud* soils are scattered generally, but the *Dunlap silt loam* occurs principally to the west and southwest of Hemingford. It has a brown to dark brown surface soil 6 to 12 inches deep, underlain by a

dark brown compact heavy silt loam which passes gradually through a grayish-brown, heavy silt loam into a light, floury calcareous silt loam. The type occupies high, flat areas.

High terraces in the vicinity of Alliance are capped with the *Yale silt loam* and *very fine sandy loam* which carry considerable clay. The low terraces of Snake Creek Valley are covered with the *Tripp very fine sandy loam.*

The *Valentine loamy fine sand* occurs in the southern and eastern parts of Box Butte County. The principal soils on the bottom land of Snake Creek are the *Laurel silt loam and fine sandy loam.* They are poorly drained and alkalied in spots.

The Box Butte soils are used extensiveiy for grazing and dry farming (Figure 4). They grow large yields of wheat, corn and potatoes. Land values are a little lower than on Cheyenne Table.

Niobrara Valley has three distinct courses or divisions in Nebraska. Two of them separate parts of the High Plains, and the third division is in the northern part of the Sandhill Region. The western course of the valley lies between Box Butte and Dawes tables. It is narrow and bordered by rough lands near the Wyoming line, but widens considerably across Sioux, Dawes, and Box Butte counties where there are bold, rounded grass covered slopes and some broken stony land. The soil with largest distribution on the valley sides is the shallow phase of the *Rosebud very fine sandy loam* underlain with sand and stone. The valley floor is divided between low benches and the flood plain proper. The benches are occupied principally by the *Tripp sandy loam* and some *fine sandy loam.* The first bottom soils are the *Laurel fine sandy loam* and *very fine sandy loam.*

Much of the western part of the Niobrara Valley is grazed. Parts are dry farmed and irrigated.

The sandhill course of the Niobrara Valley is narrow and deep and closely bordered by sandhills and stony land.

The lower course of the valley which is east of Valentine is narrow U-shaped to V-shaped. The slopes east of Keyapaha and Rock counties are more gradual and occupied in most of their parts by the Pierre shale which forms a very heavy soil similar to that of the northern parts of Hat Creek and White River basins, but occurring under a heavier rainfall.

The Pierre clay soils extend into the Ponca Creek Valley as far west as the town of Butte. They occupy much of the slopes bordering the Niobrara in Boyd and Knox Counties.

Dawes Table extends through Sioux, Dawes, and Sheridan counties. It is between Niobrara Valley and Pine Ridge, but is not distinctly set off from the latter. The surface grades from a typical table in Dawes County

to a rolling surface in Sheridan and Sioux counties. Some parts are badly dissected.

The soils of Dawes Table are classed with the *Rosebud* and *Dunlap* series and resemble those of Box Butte and Cheyenne tables. The *Rosebud very fine sandy loam* and a *shallow phase* of the type occupy much of the rolling land. The *Dunlap silt loam* is on the flat table. Much of the table is successfully dry farmed to wheat, rye, corn, and potatoes. Lands are advancing in value.

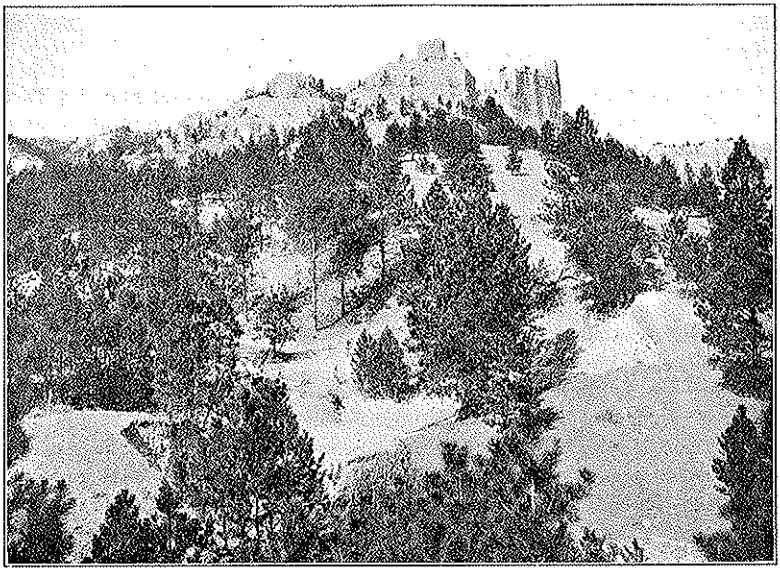


Figure 5. A Pine Ridge View, Church Butte, Sioux County, Nebraska.

Pine Ridge is a mountainous country of irregular form, which in a general way lies between Dawes Table, Hat Creek, and White River basins. It was eroded of the High Plains. The north face of Pine Ridge is very steep at most places. It contains deep canyons, prominent cliffs, and long steep slopes (Figure 5). There are two escarpments or cliff elements in this face of the ridge one of them lying just below the table land level, and the other coming down to the borders of Hat Creek and White River basins. There are a number of park land areas between these rough parts of Pine Ridge.

Much of the Pine Ridge country is covered with scattered pine trees. The steeper slopes are bare and the more gradual ones are grass covered. Parts of the park land are farmed. Soils range between stony land and the *Rosebud very fine sandy loam.*

Hat Creek Basin occupies the extreme northwestern part of the state and extends into South Dakota. It slopes away from Pine Ridge. The southern part of the basin is composed of long rounded slopes and low butte-like forms. The soils of this division are classed under two series, *Dawes* and *Epping*. They form the so-called yellow gumbo belt, which is less heavy than the name would indicate. The soils range between silt loam and fine sandy loam.

The northern part of Hat Creek Basin is occupied by billowy hills developed on the Pierre shale. The soils range between clay and a clay loam. They are dark gray to brownish, quite thin at places, become very sticky when wet, and hard when dry.

Much of Hat Creek Basin is gravel. Some is dry farmed and small areas are irrigated. Land values are held back because of inadequate transportation facilities.

White River Basin is bordered on the south and west by the steep slopes of Pine Ridge, from which open many small valleys. The lower slopes of the ridge are long and billowy. They were formed on the Brule clay and part of the soil is classed as *Epping silt loam*. The more gradual slopes have a deep silt loam soil with a heavy middle layer. This type is called the *Dawes silt loam*. The two soils just named form a belt which reaches northward to White River in most of Dawes County and follows northwestward around the edge of Pine Ridge on the west. These soils become slippery, but not very muddy, when wet. They are grazed and successfully dry farmed.

The northern part of White River Basin is the well-known dark gumbo land formed on Pierre shale. The soil is very heavy and sticky when wet. Much of it is grazed, some is farmed principally to small grains.

The valleys of White River Basin have narrow flood plains and bench lands. The bench land soils, which range between silt loam and fine sandy loam, are dry farmed and irrigated.

Springview Table is in Keyapaha County, but extends short distances in Cherry and Boyd counties. Its surface is divided between hard smooth land, rough broken land, loose sandy soil, and small dunesand areas. Much of the hard land contains gravel at or near the surface. This table is grazed and dry farmed. Its isolated position is a drawback.

Ainsworth Table, in northern Brown County, is nearly surrounded by sandhills. The surface is smooth to rough and divided between hard land and small areas of *dunesand* and *Valentine* soils. The soil with the largest distribution is the *Rosebud fine sandy loam*. A small area of silty clay occurs east of Bassett. Ainsworth Table is used for pasturage, the production of native hay and for farming. It is well developed at places. Much prairie hay is produced here.

Holt Plain, in northern Holt County, and southwestern Knox County, is the easternmost area of the High Plains Region. It is quite smooth on the upland proper, but rough near Brush, Eagle, Bird and Verdigre creeks. Most of the plain is hard land, but parts are sandy.

The soils with largest distribution are known as *O'Neill loam, O'Neill gravelly loam* and *Valentine sand.* Sandy soils, which blow, occur in the north and northeastern parts of the plain.

The O'Neill loam is a dark gray to brown loam about 10 inches deep, underlain by 10 to 15 inches of light yellowish-brown clay loam, below which is a thick bed of sand and gravel. The gravelly loam type has a thin surface soil and coarse subsoil.

In recent years, most of the best land of Holt Plain has come under successful cultivation. Some of the land has advanced to more than $150 an acre. Wheat, corn, oats and native hay are the main crops.

THE SOIL SURVEY AND ITS USE

A considerable part of Nebraska has been covered by soil surveys made by state and federal departments. Persons dealing in real estate or expecting to buy land in Nebraska will find useful information in the various county reports.

Information regarding the surveys can be secured from the Conservation and Soil Survey Department of The University of Nebraska, Lincoln, or from the U. S. Bureau of Soils, Washington, D. C.

Soil the Greatest Natural Resource—Most Nebraska soils are deep, fertile, stone-free and easily tilled. Practically no artificial fertilizer is used. Humus is replenished in crop rotation by growing legumes. These unusually favorable conditions, as compared with most states, are not as fully appreciated as they should be by those who own Nebraska land.

Land Frauds—The Nebraska Conservation and Soil Survey serves the citizens of the state as an information bureau in regard to foreign realty. It is in close touch with the state and federal surveys and therefore in a position to secure reliable information concerning the soils of other states, i.e., in so far as they have been described and mapped. It is particularly noticeable in this connection that some of the states for which there is most need for information have done very little in the line of soil survey. This lack of information offers an inviting field for land promoters, and makes it necessary for our department to send men to inspect some of the foreign projects wishing to sell in Nebraska.

Importance of Subsoil—Land sales should be made on a basis of careful examination and report. More care should be used here than in buying a house or some security.

The subsoil should be examined by digging or by boring. A thin surface soil on shale or on sand is drouthy.

One of the main reasons why Nebraska ranks so high in agriculture is the deep, mellow subsoil.

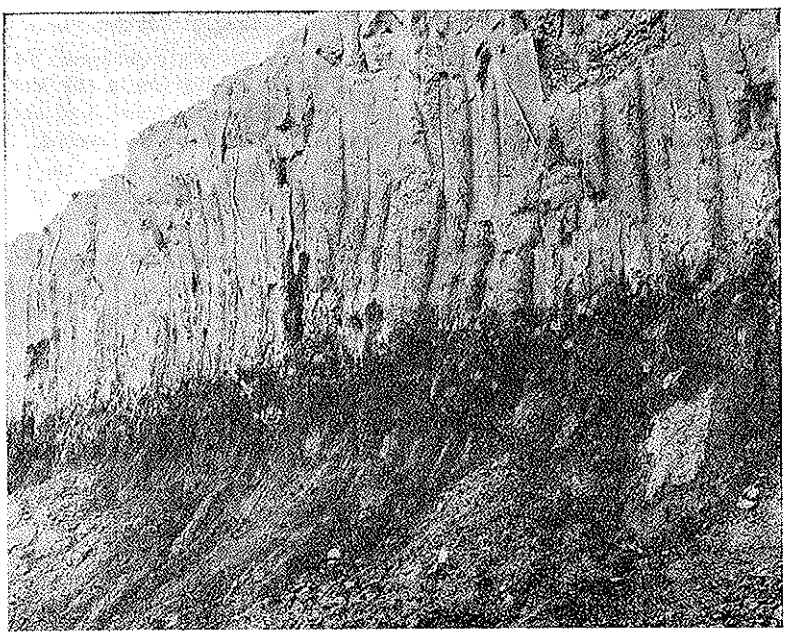


Figure 6. A Nebraska soil section showing the unusually deep subsoil.

THE CLIMATE OF NEBRASKA

By GEORGE A. LOVELAND,
Meteorologist, U. S. Weather Bureau

The principal elements of climate are temperature, humidity, rainfall, sunshine, wind, and storm. For Nebraska, they are as follows:

Temperature—The average temperature of this state decreases from east to west and south to north. The mean is 51 degrees in the southeast, 50 degrees in the southwest, 48 degrees in the northeast, and about 45 degrees in the northwest. The highest temperature on record, 115 degrees, was in 1918, and the lowest, 47 degrees below zero, in 1899. From 1876 to 1918, a period of 42 years, the average temperature of the state was 48.6 degrees.

January, the coldest month, has a mean temperature of 28.1 degrees, being 25 degrees in the southeast and about 20 degrees in the north. February and December are slightly warmer. July is the warmest month, although the hottest days of the year may occur in June, July, August, or September. August is slightly below July and thereafter the decline in temperature is gradual. Summer evenings usually are cool compared with mid-day.

Frosts—The growing season (free from frosts) is about 160 days in the southeastern counties and 130 days in the northwest. Spring approaches the state from the southeast and fall and winter enter from the northwest.

Light frosts sometimes occur throughout May and in early June in the northwestern counties. The last killing frost of spring in the eastern counties is usually in late April or early in May. It is from May 10th to 15th in the northern and western parts of the state.

Humidity—The relative humidity averages about 70 per cent in Nebraska. It is highest in mornings and lowest in the early afternoon. It is higher in winter than in summer. The western counties have a lower humidity than the eastern counties. There is a close relation between the relative humidity and the amount of precipitation.

Rainfall—The average rainfall for the state between 1876 and 1918 was 23.64 inches. The eastern counties have more precipitation than the western counties. There is a gradual decrease in amount from east to west (See Figure 7). The annual rainfall for different parts of the state the past forty-two years is as follows:

Southeastern part 29.87 inches.
Northeastern part 27.43 inches.
Central part 24.49 inches.
Southwestern part 23.03 inches.

Northwestern part 19.11 inches.

Western part 17.72 inches.

The records show some fluctuation in the amount of rainfall by periods of years, but no definite and reliable statement can be made regarding the distribution of these periods and their probable occurrence in the future.

The rainfall occurs principally in the spring and summer months. The wet season, May to July, inclusive, has 46 per cent of the annual rainfall. The heaviest and most evenly distributed rainfall comes in June and decreases to January which has less than one-sixth that of June. The June rainfall is over five inches in the southeastern counties, and less than three inches in the west. The driest period of the year, so far as the effects of precipitation and evaporation on crops is concerned, is apt to be in July and August.

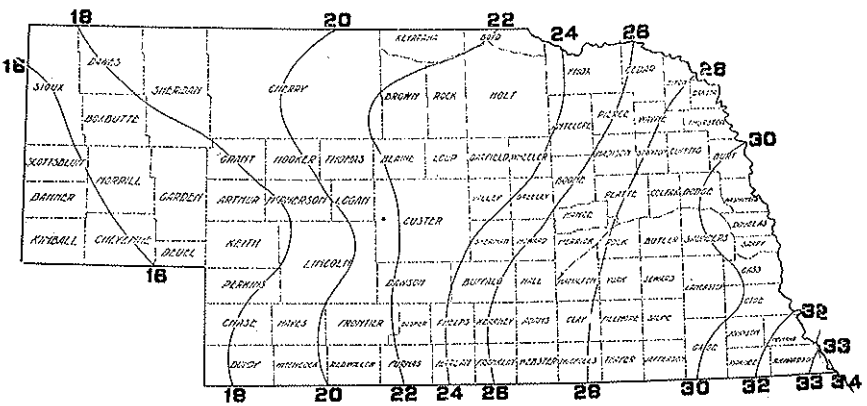


Figure 7. An outline map showing the distribution of annual rainfall in Nebraska.

The annual monthly rainfall for the state from 1876 to 1918, which shows the heaviest precipitation during the growing season, is as follows:

January	.52 inches
February	.72 inches
March	1.11 inches
April	2.41 inches
May	3.63 inches
June	3.81 inches
July	3.43 inches
August	2.81 inches
September	2.13 inches
October	1.57 inches
November	.68 inches
December	.74 inches

The dry season comes from November to February with 11 per cent of the annual amount of moisture. Most of the precipitation of these months is snow, which averages 28 inches, making 2½ inches of water. The average amount of snow increases from November to January and February.

Sunshine—The state, as a whole, has a comparatively large amount of sunshine. The cloudiness is greatest in the eastern and southeastern counties and comes in association with rain and snow.

Winds—The average wind velocity, though not exactly known, is about 9 miles per hour for the state. It averages highest in the western counties and lowest in the southeast. March and April are the windiest months with averages of 10.6 and 11.5 miles per hour. July and August, the calmest, average 7.4 and 7.7 miles per hour. The highest velocities of record have occurred in thunder storms. The maximum has been about 80 miles per hour.

The prevailing wind direction is from the north and northwest from October to May; from the south and southeast in May, June, and July; and from the south from August to September.

Storms—Cyclones are the movements of air over large areas which bring to Nebraska the rainfall, change in cloudiness, and temperature and sometimes develop storm conditions, especially in the southeastern part. Tornadoes coming also in association with the cyclones are not very common. Far the largest amount of damage done in the state was during the year of the well-known Omaha tornado.

Destructive hail storms are of record. The effect is over small areas.

Healthful Climate—Viewed as a whole, the climate of the state may be regarded as healthful beyond the average. Under the wide range of conditions in elevation, between altitudes of the 840 feet and 5,340 feet, and because of the range in temperature, sunshine, humidity, cloudiness and precipitation, one may select a place in the state to suit the required conditions as may relate to healthfulness.

MINERAL RESOURCES

By G. E. CONDRA,
Director, Conservation and Soil Survey.

Nebraska has higher rank in production from these resources than is generally supposed. Among the important resources are sand, stone, clay, volcanic ash, and potash. There are small deposits of coal, and prospecting for oil and gas is being done at a number of places.

SAND RESOURCES

The sand resources have been investigated and published by the State Geological Survey and the State Conservation and Soil Survey. A report of about 200 pages, now out of print, was prepared by the writer and published by the Geological Survey, and Bulletin 6 of the Conservation and Soil Survey is available for distribution as long as it lasts.

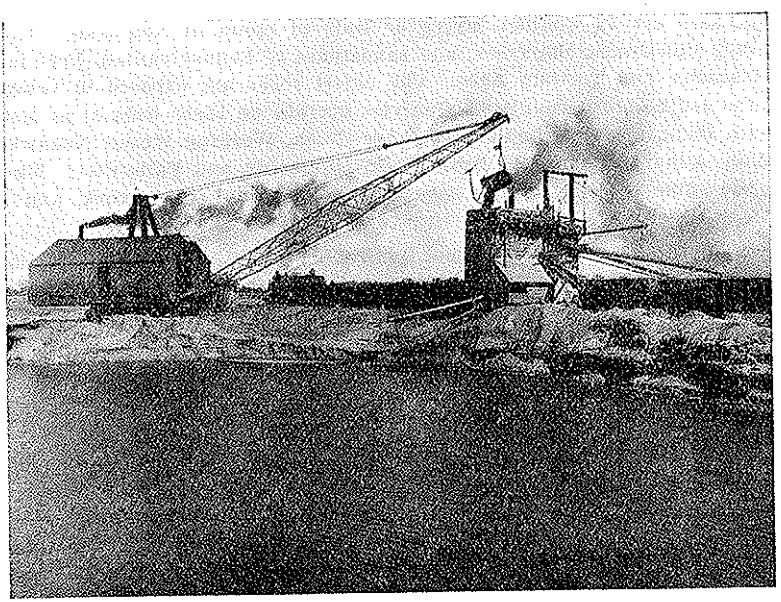


Figure 8a. Sand Dreging near Fremont.

The sand resources of Nebraska are widely distributed. The largest deposits, along the Platte, are worked in open pits and by dredging and pumping. Sand and gravel of good quality are produced from this

source on a commercial scale, and shipped throughout Nebraska and to other states. There are more than 20 large producing centers as at Kearney, Grand Island, Central City, Columbus, Schuyler, Fremont, Valley, Ashland, South Bend, Meadow, and Louisville. The finer sand is used for engine sand and plaster and the coarser grades, some of which are prepared by screening, are used for concrete and other purposes. There are large sand plants in Salt Creek Valley, at Lincoln.

Bank sand, exposed in valley sides, is worked at several places. About 1,000 pits produce from this source. Among the leading centers of production are Bayard, Long Pine, Tekamah, Salem, Fairbury, and near Red Cloud. Much of the bank sand goes for local use. Some of it is shipped.

Extensive road building in Nebraska calls for large quantities of sand for surfacing and for use in concrete. Fortunately the state has adequate resources with which to meet this demand.

STONE RESOURCES

There are 34 distinct layers or beds of stone in Nebraska. They include limestones, chalkrock, and sandstones of Pennsylvanian, Permian, Cretaceous, and Tertiary ages. The oldest rocks are exposed in valleys of the southeastern counties. Quarries operate on these beds at or near South Bend, Meadow, Louisville, Cedar Creek, Weeping Water, Nehawka, Union, Auburn, Tecumseh, Table Rock, Humboldt, and Falls City. Much of the stone is used for the base in the road and street work, and in concrete.

The sandstones are of a poor quality, as a rule. The Dakota Formation which outcrops at places between Dixon and Jefferson counties is a source of some sandstone. The Tertiary formations, exposures in the central and western parts of the state, yield some lowgrade sandstone, but there are local deposits of very good stone in the vicinity of Lookout Mountain, Franklin County, and at places in Knox, Boyd, and Holt counties. This stone is well suited for concrete.

A thick formation, known as the Niobrara Chalk, outcrops along the Missouri between Boyd and Dixon counties, along the Republican at Cambridge and in the vicinities of Bloomington, Franklin, Guide Rock, and Superior. It is also exposed at a few places between the Missouri and the Republican. The stone is too soft for general building purposes, but has been used to some extent. It is a good cement material and suitable for surfacing dirt roads.

The stone resources of the state have been surveyed by the Conservation and Soil Survey and tested in cooperation with the College of Engineering at the University. Persons wishing further information should write the Conservation and Soil Survey for Bulletin 5.

CLAY RESOURCES

There are a number of deposits of clay and silt in Nebraska, some suitable for the manufacture of brick and tile. Unfortunately a great deal of the best clay is thickly covered with mantle rock, making its working comparatively expensive. The silt occurs more favorably.

The clay deposits are in the Pennsylvanian, Permian, Cretaceous, Tertiary, and later formations. Clays and shales, interbedded with limestone and exposed in the southeastern counties, are of Pennsylvanian and Permian ages. Some of the exposures are worked, as at or near Nebraska City, Auburn, Humboldt, and Table Rock. The clays at Tekamah, Lincoln, Beatrice, Fairbury, and Steele City, are principally of Cretaceous age, occurring in the Dakota Formation. Clays of western Nebraska, belonging to the Tertiary formations, have been used for brick in a limited way. The drift deposits of the eastern counties and the loess deposits distributed so generally over the southeast half of the state are used in brick-making, but to best advantage when mixed with materials of finer texture. Brick plants operating on these deposits as at Hooper, Hastings, York, and Omaha, usually ship some clay from the Dakota formation or from the clay-shale beds of the Pennsylvanian formations.

Brick Yards—There are 36 successful brick plants in Nebraska. The clay resources and strong demand for clay products warrant the expansion of brick and tile manufacture. The state produced 127,000,000 brick and tile (brick measure) in 1918, and 122,000,000 in 1919.

THE CEMENT INDUSTRY

Though lime was made at several places in the state during the early history, the manufacture of Portland cement was delayed until a few years ago, when a cement plant was built at Superior (Figure 8). It operated for a while, was abandoned one year, and rebuilt and enlarged. This plant, owned by the Nebraska Cement Company, is now in successful operation, producing high-grade cement. The capacity is to be enlarged to 2,500 barrels per day.

The cement materials of Nebraska are principally in the Pennsylvanian and Cretaceous formations. They are limestones, shales, and chalkrock. Some of the limestone members of the southeastern counties have been tested and found suitable for cement making. The Niobrara chalk and shales immediately below and above it are the state's principal cement resources. The chalk is widely exposed along the Missouri between Knox and Cedar counties and in the Republican Valley, where it is here overlain by Pierre shale and underlain by Carlile shale.

Cement Plant at Superior—This large plant is located just west of Superior. The quarry is 2½ miles south of the mill and across the

Kansas line. The materials, being the chalk underlain by Carlile shale, are quarried without the hindrance of much overburden and transported to the mill by cars and small locomotives. The chalk is worked with a steam shovel and to a depth of about 30 feet. The materials have the proper chemical composition for cement.

What is known as the wet process of manufacture is used at the mill. The materials are crushed, ground, and mixed to a slurry and burned at a temperature of 2800 degrees F., the resulting material being black nodules called clinker. The burning is done with powdered coal fed

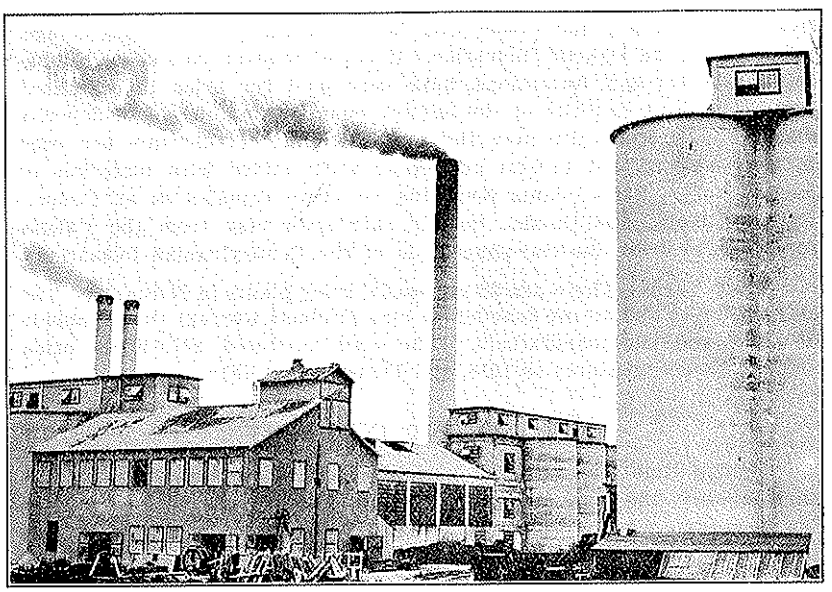


Figure 8. The Portland Cement Plant at Superior, Nebraska.

through the kilns by currents of air. From the kilns the clinker is carried to rotary coolers and then to storage or directly to the grinding machinery. Before being ground the clinker is weighed and about 2½ per cent of gypsum is added to act as a retarder for the set of the cement. The final act is grinding the clinker to cement. The cement is placed in storage and shipped to points in Nebraska and other states.

The cement plant at Superior is modern in every respect with electric drive throughout. The stock of the company is owned principally by Nebraskans, and there is a stronger demand for the production of the plant than can be met.

VOLCANIC ASH

This material is widely distributed in Nebraska and adjacent states. It is light or light gray and powdery or loosely cemented. The particles are fine, hard, and sharp, making the material suitable for abrasive purposes.

For several years most commercial production of volcanic ash was from deposits in the Republican Valley. The principal place from which the material was secured is between Orleans and Stamford. Here a good quality of material occurs beneath a thin overburden. The overburden was removed with team and scraper and the ash loaded into cars for shipment to Omaha and other places.

The volcanic ash deposits of Nebraska have been used principally by the large packing house companies in the manufacture of Old Dutch Cleanser, sapolio, and similar materials.

COAL IN NEBRASKA

The greatest drawback in Nebraska is a lack of fuel. Coal occurs plentifully in all bordering states from which it is shipped. There are a number of thin seams of coal in Nebraska in the Pennsylvanian and Cretaceous formations, but none of them are now worked. Several years ago, drifts were opened on thin beds along the Missouri and in the southern parts of Richardson and Pawnee counties to mine coal for local use. Later a small mine was operated for a short time near Peru.

Beds of low-grade lignite have been encountered in artesian wells drilled into the Dakota Formation. A thick carbonaceous shale at the base of the Pierre Formation, exposed near the mouth of the Niobrara, and at places in the Republican Valley, has been mistaken for coal. It is now generally believed that the chance to discover coal of economic importance in Nebraska is small, as shown by a study of the geological formations and by drillings.

OIL AND GAS

The geology of the state is quite well known, except where there is a deep covering of mantle rock. Such knowledge as we have of the structure indicates that there is some chance for the discovery of oil and gas, yet the drillings in several counties have not made discoveries.

The State Conservation and Soil Survey has the duty of gathering and keeping the records of deep wells and is in close touch with prospecting. Wells were sunk the past two or three years at or near Table Rock, Red Cloud, Bassett, Stockville, in Banner County, and in South Dakota near the Sioux and Dawes County lines. Two wells completed at Table Rock extended into granite, and condemned what was thought

to be the state's best structure and probable source of oil. The well near Stockville was abandoned at a depth of about 2,500 feet. A string of tools was lost in the Bassett well at 2,000 feet and another location was made. Drilling at Red Cloud continued below 2,000 feet. The Prairie Oil and Gas Company, operating in Banner County with the best equipment ever used in the state, abandoned a test at a depth of 5,697 feet. Two tests were made about 25 miles northeast of Chadron. They encountered a small showing of gas. One of these wells was put down a number of years ago and the other was completed last year. A well-defined structure 18 miles northeast of Chadron, and on the Nebraska side, will be tested within a year. This should contain oil and gas.

Deep wells have been drilled at Omaha, Rulo, Union, Nebraska City, Beatrice, Lincoln, Arapahoe, McCook, Lynch, Litchfield, Shelton, and Niobrara. Except those at Lincoln, Nebraska City, and Omaha the depths were not sufficient for oil and gas tests. A small amount of gas was struck at McCook.

Southeastern Nebraska is underlain with formations which extend to central and southern Kansas where oil and gas occur in large quantities. Two good structures have been worked out in the Nebraska beds. One of them, at Table Rock, has been condemned on account of granite and the other, in the vicinity of Nehawka, has not been drilled.

Much of the bedrock of central Nebraska is thickly mantled, making it practically impossible to work out the geology. Some exposures occur in the deeper valleys, but they are not sufficient to serve for complete and accurate mapping. Much of central Nebraska is too heavily mantled to be carefully studied geologically for the purpose of determining where tests should be made. There may be good structures here containing oil and gas, but their exploration remains to be done nearly wholly by drilling which will be wildcatting, first to locate structure and second to discover oil.

The western counties are known to be underlain with formations of the age of those which carry oil in Wyoming. It would seem that they might produce in Nebraska, but three conditions, somewhat unfavorable, are encountered. First, it is not possible to work the geology of the formations because of limited exposures. Second, the sands of the oil-bearing formations of Wyoming appear to thin out in the direction of Nebraska and eastern Colorado. Third, the depth in much of Nebraska will be greater than in Wyoming.

It should be recognized that the state is deficient in fuel and that prospecting for oil and gas, though more or less hazardous, should be encouraged wherever the indications favor the presence of these materials. It is quite possible that discoveries may be made and that they may prove of economic importance. Extreme wildcatting, however, and the tendency to follow fake locators should be discouraged. (See Bulletin 11 of the Conservation and Soil Survey.)

POTASH INDUSTRY

The potash industry of Nebraska grew up with the war. It advanced in three or four years to a point where the state produced about 60 per cent of the potash output in the United States. About $10,000,000 was invested in plants and pipe lines. There were 300 miles of pipe line, 9 large plants operating, and 18 small plants operating or building when the armistice was signed. The daily production was about 500 tons of crude potash.

Soon after the war, the market for domestic potash declined from about $5 per unit to less than $2.50 per unit. The plants continued to operate for several months, but their production rapidly increased in storage and there came a time, in view of the low prices and the lack of sales, when all the plants closed. The fertilizer companies, who afforded a market for the production, refused to buy because cheap foreign potash seemed to be in sight. The potash companies sought relief through the federal departments at Washington, but received little effective assistance. Following the closing of the plants a considerable amount of the potash in storage was sold at a low figure, but the situation did not improve for several months to the extent that the companies could reopen their plants.

Now most plants are operating and there is a ready sale for the potash at $2.25 and $2.50 per unit of K2O, F.O.B. Antioch, and the industry appears to have a chance for permanence. Some of the large plants are installing equipment to refine the product.

During the war Nebraska potash was shipped to the eastern and southeastern states and to Porto Rico and Cuba for use in fertilizers. It was without doubt an important factor in increasing agricultural production and thereby a factor in winning the war. Just what may be done at Washington to assist the potash industry cannot be foretold at this time. It will be necessary to protect the industry for a time against foreign production, and it seems that this will be done. A low tariff or subsidy would insure a permanent potash industry for the United States.

The potash resources of Nebraska have been investigated by the Conservation and Soil Survey. A Preliminary Report, Bulletin 8, was published and distributed generally and a detailed report in manuscript, may be issued within a few months. The Survey describes the potash region, the chemical composition of brines, the development of lakes, the origin of potash, and methods of reducing crude potash from the brines.

FOSSILS A RESOURCE

It is not generally known that there are fossil beds of great value in Nebraska. Some of the richest deposits of the United States are on the Cook Ranch at Agate, Sioux County (Figure 9). Individual specimens secured from this place and mounted in museums are valued at thousands of dollars. The "Giant Hog," in the Museum of The University of Nebraska, is listed by the curator at $50,000.00.

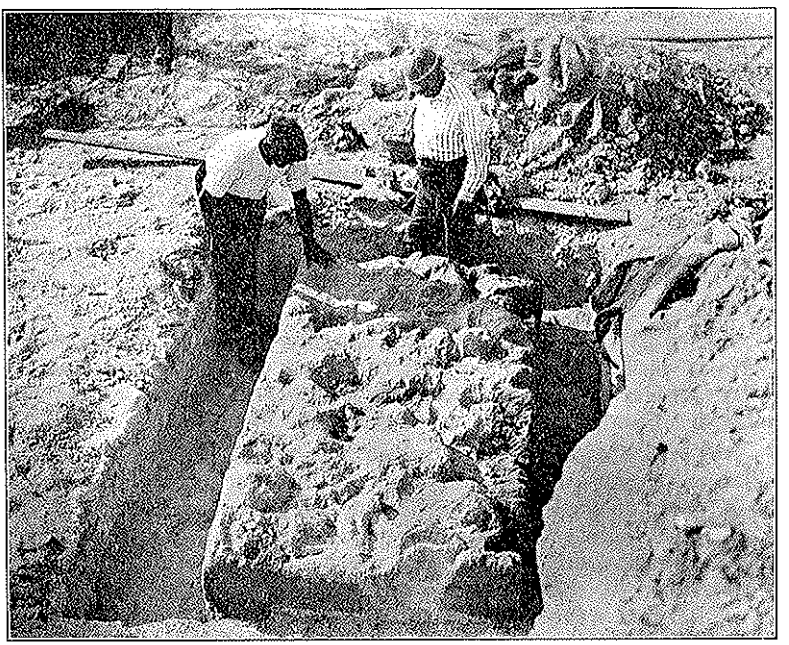


Figure 9. A large slab of fossils being removed from the Carnegie bone quarry on the Cook Ranch, Agate, Nebraska.

Some of the large eastern museums have fossil beds on the Cook Ranch from which specimens are secured for display. The University of Nebraska, through lack of funds, has not been able to maintain the lead in developing this resource.

Many people, including some of the world's best known scientists, visit the Cook Ranch in order to see and study the fossil beds and the Cook collections.

WATER RESOURCES

By G. E. CONDRA,
Director, Conservation and Soil Survey.

These resources are soil moistures, ground water, springs, lakes, and streams. They are replenished by the rainfall which soaks into the soil and subsoil, forming ground water. Most of the state's water is in the ground and not on the surface.

Soil Moisture—The upper part of the soil contains capillary water or soil moisture from which crops are supplied. The moisture of this zone is one of the state's valuable resources, and its conservation has great importance in agriculture.

Ground Water—Below the zone of capillary water, the mantle rock and much of the bedrock are saturated. The amount of water stored in this zone would be enough, if at the surface, to make a lake many feet deep. This water is of good quality as a rule, and has value in being the source of well water and springs.

WELL WATER

Good well water extends under most of the state at comparatively shallow depths. It occurs principally in beds of sand, and in more than one bed at most localities making it possible to tap a first, second or a third source supply.

Shallow wells are obtained on most alluvial lands and sandhill valleys at depths from a few feet to thirty or forty feet. Much of the alluvial water is of good quality, in the deeper sands especially. Though most of the sandhill water is good, that of shallow wells in the potash region may contain alkali. Deeper wells at such places afford an abundance of desirable water.

The Loess plains are underlain by broad sheets of water-bearing sand which afford strong wells and good water at depths ranging between 70 and 225 feet, the greater depth being westward.

The table land wells of the western part of the state are 80 to 300 feet deep. Here tubular wells supply large quantities of unusually good water.

The water obtained from some of the clay lands in White River and Hat Creek basins is scant and of poor quality.

There are places on valley slopes along the Republican, and in some southeastern counties, where it is not possible to secure well water of sufficient volume. Such places are where the ground water has drained from above clay or shale beds, making what are called dry zones or belts. These belts are narrow, and in most places water

can be obtained by sinking wells on the uplands or on the valley floors below.

As a whole, Nebraska has excellent well water. The supply is large and quite free from pollution. The State Conservation and Soil Survey assists in prospecting water resources and in determining the quality and quantity of water available for rural and urban purposes. This department cooperates with the State Bacteriologist of the State Health Department and the State Engineer in the work of locating and correcting water supplies.

ARTESIAN WELLS

Ground water under pressure is artesian. A flow is obtained by tapping a supply under pressure which forces to the surface. In many cases the water rises only a short distance, not far enough to overflow.

The state has several hundred artesian wells reaching formations of different ages and depths. Shallow wells, depth 25 to 200 feet, occur in some of the western and north-central counties. Most of them are in western Dundy, western Chase, Sheridan, Cherry, Brown, and Holt counties. The water comes from deposits of Tertiary or later age. Some wells north of Hyannis are 200 to 450 feet deep.

Artesian water of the Dakota Formation is reached by wells in Knox, Cedar, Dixon, Seward, and Lancaster counties. The depth ranges from 90 to 1,000 feet. Much of the water, though somewhat mineralized, is suitable for drinking purposes. The Survey has records of about 300 of these wells, many of which occur in Cedar and Dixon counties.

The deep wells at Lincoln, Beatrice, and Omaha extend to formations of Pennsylvanian and older ages. Most of them yield salt water, some of which is used for sanitarium purposes.

Though practically all of the state is underlain with artesian water, there is not a strong demand for this supply, because of the prevalence of good shallow water.

LAKES

There are many small lakes in Nebraska, some of them are permanent, but most of them intermittent, appearing during a wet season or during a period of wet years.

Most lakes are in the sand hills, as in southwestern Holt County and adjacent areas, south of Bassett and Ainsworth; in northwestern Cherry County; southwest of Woodlake; southeast of Alliance, and north of Antioch. Among the best known sandhill lakes are Enders, Dad's, Dewey, Hackberry, Big Alkali, Jesse, Snow, Crescent, and Blue. Some of these are fresh; others contain alkali. Most sandhill lakes

are shallow. They are used for stock water, fish culture, hunting, and as a source of potash.

Numerous wet-weather lakes occur on the Loess Plains, Cheyenne Table, and Box Butte Table. The total area of their beds is about 225 square miles. These intermittent lakes have some importance in hunting.

Cut-off lakes occur in the Missouri, Elkhorn, Loup, and other valleys. Carter Lake at Omaha is a notable example of this kind. Cut-off lakes are used for boating, fishing, sources of ice, and locations for recreation clubs.

Large artificial lakes for ice production are at Seymour, Ashland, Memphis, and other places. Some lakes are formed by damming streams for water power. They are sources of ice and places for pleasure resorts. Among the best known locations of these are Beatrice, Milford, Fairbury, Hebron, Deweese, Falls City, Cambridge, Maywood, Ericson, Sargent, Ainsworth, Long Pine and Valentine.

A few irrigation reservoirs have been built, two being quite large. They are Lake Alice, north of Scottsbluff, and occupying about 700 acres, and Lake Minatare, north of the town from which it was named, and having an area of about 2,500 acres. These lakes are flood waters stored for irrigation.

SPRINGS

There are many small springs in the state, in fact most small streams are spring-fed. Springs are common in the Pine Ridge Region and along the Niobrara. Seepage is observed about most sandhill lakes. Rivers heading in the sandhills are fed by large springs. The ravines of the Missouri, Elkhorn, and Republican contain many small springs. Springs occur at a number of places along the outcrops of the Dakota Formation between Dixon and Jefferson counties.

Fortunately, spring water is available at most places in the state where it is difficult to secure well water.

RIVERS AND WATER POWER

The principal rivers of Nebraska are the Missouri, White, Niobrara, Elkhorn, Loup, Platte, Republican, Little Blue and the Big Blue. These are used for fish culture, boating, park purposes, water supplies, water power, sewage disposal and irrigation. The flow of most rivers fluctuates considerably during the year. The Loup and the Niobrara are quite uniform in discharge.

The Missouri River borders the state on the east for a distance of about four hundred and sixty miles. The grade in this distance averages a little less than one foot per mile, yet the current is quite

swift. The river has a tendency to shift its course, and to destroy a large amount of valuable land. Whole farms have been destroyed within a year. Plans are under way to check this destruction. The control will require a large outlay but the results should prove beneficial to land owners, railroads, cities along the course, and to the state as a whole.

The Missouri has not been used for power in Nebraska. Plans have been advocated for its development. A number of the tributaries, such as the Ponca, Bazile, Bow, Aowa, Tekamah, Papillion, Weeping Water, Little Nemaha, and Big Nemaha were developed several years ago. Most of these powers have been abandoned on account of the small, irregular flows, floods, and channel changes made by drainage. There were four powers in the Little Nemaha, and eight in the Muddy and branches of the Big Nemaha. Two small powers remain in Bazile Creek and one in Bow Creek.

The chief uses of the Missouri are for city water supplies and sewage disposal. The water at Omaha is pumped from the river and treated, making an abundant supply of good quality. The Missouri presents possibilities in navigation, yet nothing permanent has been accomplished in this line.

White River heads principally by branches in Pine Ridge of Sioux, Dawes, and Sheridan counties. The main branch starts south of Harrison and flows past Andrews, Glen and Crawford. The small streams joining on the south are Ash, Indian, Dead Horse, Chadron, Bordeaux and Beaver. These resemble mountain streams. They have swift, cool waters and are used for stock water, rural homes and irrigation. The city of Chadron is supplied from a reservoir in Chadron Valley.

Though there are no powers in White River drainage, small powers could be developed for ranch lighting and for pumping.

The Niobrara or Running Water heads in Wyoming, but receives very little water from that source. The river is largely a Nebraska stream. It is only a few feet wide at the Wyoming line and remains a small stream until the sandhills are reached. Here the volume rapidly increases and the flow becomes quite uniform. The lower course of the river is wider, more shallow and less even in discharge.

The drainage area of the Niobrara is about nine thousand square miles of high plain and sandhill country. The prevailing soils of the basin are fine sandy loam, sandy loam, dunesand and rough stony land in the upper and middle courses. There are areas of finer textured soils in the lower course.

The Niobrara Valley is quite deep, bordered by rough land in the western part, and somewhat wider before the sandhills are reached. The middle course is deep and bounded by bluffs and stony land. Here the river flows over a number of rock outcrops making rapids. Farther down stream, near the Missouri, the river valley is wider.

Much of the Niobrara water comes from springs issuing from sandhills. The flow is quite uniform with a discharge of 870 second feet or more at Valentine and more than 1,000 second feet at Niobrara. The leading tributaries are Snake River, discharge 200 to 300 second feet; Minnechaduza Creek, 30 or more second feet; Plum Creek, 15 to 75 second feet; Long Pine Creek, 50 to 100 second feet; Keyapaha River, 50 to 200 second feet; Eagle Creek, 10 to 25 second feet; and the Verdigre, 40 to 100 second feet. These discharges are approximately correct.

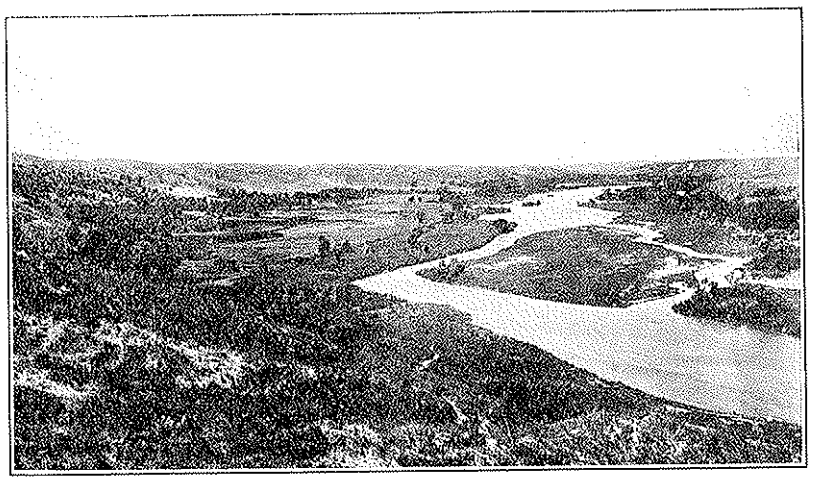


Figure 9a. The Niobrara, where it enters the Sandhills.

The western part of the Niobrara is generally used for irrigation. It is diverted through a number of small canals and the land near the stream is sub-irrigated. The middle course of the river has a number of waterfalls, which, with the rugged topography and tree growth, make one of the scenic parts of the state. These falls occur in Snake River, Schlagle Creek, and where small streams drop into the river. There are beautiful parks along Minnechaduza at Valentine and in Long Pine Valley at Long Pine. The Minnechaduza and Plum Creek reservoirs afford fishing, boating, and bathing.

Several powers have been developed in tributaries of the Niobrara. These are in Pine, Minnechaduza, Plum (Figure 10), Long Pine, Keyapaha, Eagle, and Verdigre creeks. The largest development is in Plum Creek northwest of Ainsworth, from which electric current is transmitted to Ainsworth, fourteen miles, and Bassett, thirty-four miles, where it is used for power and light. The Keyapaha plant washed out in 1915 and has not been rebuilt. Eagle Creek dam went out

several years ago. Several power possibilities remain in the tributaries of the Niobrara. Some of the most desirable sites are on Snake River about twenty miles southwest of Valentine.

About 80,000 theoretical horsepower could be developed in the Niobrara and its tributaries. A market for at least part of this could be secured through long distance transmission to Sioux City and other places.

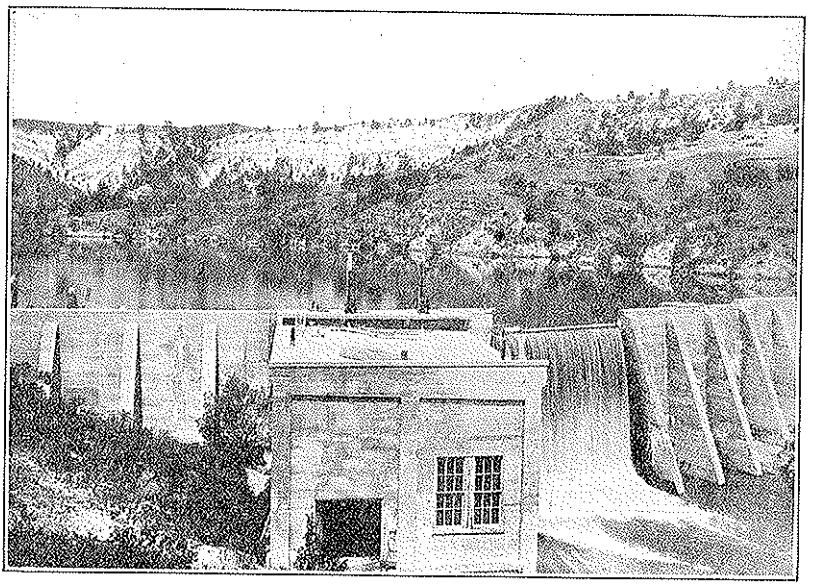


Figure 10. The Plum Creek Dam northwest of Ainsworth.

The Cornell Project, the only development in the trunk stream, is four miles east of Valentine. The dam and other structures are concrete. Electric current is developed and transmitted to Valentine and used principally for lighting. The Cornell Project is one of the largest in the state, capable of generating about 2,000 horsepower, which can be increased if a larger market is secured.

Elkhorn River, in northeastern Nebraska, drains sandhill, loess plain and loess hill areas. The valley is wide and shallow in the upper part and deeper in the lower course. The stream is sluggish at the headwaters and quite swift in the middle and lower parts, having a comparatively uniform discharge at the Platte of 1,200 or more second feet.

North Fork, entering at Norfolk, is one of the principal tributaries. It overflows most years, interfering with power, but there is a develop-

ment at Norfolk. A power, in the Logan at Oakdale, fell into disuse on account of drainage in which the old course of the creek was abandoned.

The trunk stream of the Elkhorn is used for the sub-irrigation of extensive hay flats near its headwaters. It has been developed for power at Atkinson, Battle Creek, and Neligh, and a number of other places. These, except at Battle Creek and Neligh, have been destroyed by high waters. The type of construction was not suited to a sandy bed. The Neligh development is for 300 horse power under a head of 12 feet. Two long dikes extend up the valley from the ends of the dam to check washing by high water.

The Loup System is in central Nebraska. The drainage basin, with an area of about 14,000 square miles, includes sandhills, loess plains, loess hills and broad valley bottoms in which bench lands are a feature. The rivers head in the sandhills. The rainfall soaks into the hills, is conserved and doled out to the rivers through thousands of springs. The ground water gives to the rivers a uniform flow so characteristic of this system. The run-off is larger, compared with the drainage area, than in the other Nebraska rivers. The principal tributaries and their approximate mean discharges are as follows: The South Loup, 150 to 300 second feet; Muddy Creek, no record; Dismal River, 300 to 400 second feet; Middle Loup, about 1,000 or 1,100 second feet; North Loup, about 1,000 second feet; Calamus River, 400 second feet; Spring Creek, no record; Cedar Creek, 100 to 200 second feet, and Beaver Creek, 50 to 150 second feet.

Dismal River is a branch of the Middle Loup, and Calamus River is a branch of the North Loup. The Loup proper is formed by the junction of the Middle and North branches near St. Paul. The discharge of the Loup at Columbus is rarely below 1,300 second feet in the summer and early fall. It is about 3,000 second feet most of the year. Though the headwaters of the Loup are not much affected by floods, the lower course experiences them practically every spring, due to ice gorges, melting snow and rains.

The Loup valleys are comparatively wide and open. The upper slopes are hilly and the valley floors divide between flood plain and bench land. The streams, flowing upon sandy beds, have a tendency to shift position. The valley grades or slopes between 6 and 7 feet per mile. Several small waterfalls occur in Dismal River, and two occur in the North Loup.

There are a number of power developments in the Loup tributaries, as at Albion, St. Edward, Fullerton, Ericson, Sargent, Loup City, Callaway, Mason City, Litchfield, Ansley, Ravenna, and Dannebrog.

The Boelus is the largest power project in the state. The water is diverted from the Middle Loup southwest of Boelus, and carried east-

ward about four miles through a large canal to a bench of the South Loup. Electric current is generated under a head of about 20 feet and transmitted twenty miles to Grand Island and distributed to a number of towns and cities. The plant has a capacity of about 3,000 horse power.

The Boelus project experiences much difficulty with sand and slush ice and is supplemented by steam power as is the case with practically all Nebraska water powers.

Undeveloped Power Projects—Two large projects have been surveyed and advocated for the lower part of the Loup near the junction with the Platte. They are known as the Babcock and Commonwealth. The first of these proposes to divert from the river southwest of Genoa and extend a canal down the north side of the valley, reaching the high land northwest of Columbus. The length of the canal would be about 25 miles and 21,477 horse power would be developed under a head of about 70 feet. Some work has been done. A canal now reaches from the river to an abandoned power house on Beaver Creek south of Genoa.

The Commonwealth Project plans to tap the Loup west of Columbus, just below the return of the Babcock, and to extend the canal 19 miles down the valley to the upland north of Schuyler, from which a return canal about 4 miles long would reach the Platte southeast of Schuyler. The grant is for 2,000 second feet and 15,000 horse power under a head of 66 feet.

The main branches of the Loup have a number of power possibilities. Projects could be surveyed at several places in addition to those popularly thought to be the best. The valley floors slope sufficiently to permit diversion, and the use of canals leading upon low gradients to the bordering valleysides from which water could be dropped in generating power. The Loup powers will be costly and difficult to maintain.

The Platte is Nebraska's most valuable river. It enters the state by two branches. The South Platte comes in from the mountains and plains of Colorado and the North Platte enters from the mountains and table lands of Wyoming and Colorado. The South Platte occupies a broad U-shaped valley bordered by gradual to steep slopes in which the prevailing soils are sandy loams and gravelly loams. The stream is on a sandy bed among low islands. The discharge is variable, and the stream dwindles in summer to small channels and even to a dry bed. The winter flow averages about 1,000 second feet. The maximum discharge is about 7,000 second feet. The low stage is caused by the withdrawal of water for irrigation in Colorado and by evaporation. Some land is irrigated from this stream in Nebraska, but the state does not receive its just share of water.

Below the junction with the North Platte, the Platte occupies a broad valley in which the flood plain, bench land, and bluff lands are well defined. The river is broad and shallow. It has a tendency to decrease in volume until the Loup is reached. This shrinkage is caused principally by evaporation and irrigation. The volume of water received through the Loup at Columbus is considerably greater in summer than that of the Platte. This influences the flow of the Platte making it permanent to the Missouri.

Lodgepole Creek is the main tributary of the South Platte in Nebraska. It is almost completely used for irrigation. Water is stored in a large reservoir and several ponds made by dams. The reservoir, seven and one-half miles west of Kimball, holds water for the largest irrigation enterprise of the valley, to irrigate about 7,000 acres in the vicinity of Kimball. Much other land in the valley is covered by small ditches.

The North Platte is fed principally by snow and spring waters of Wyoming. More than one million acre feet of flood water is stored in the Pathfinder Reservoir about 45 miles southwest of Casper and released during the irrigation season. This storage water flows on the river bed and through big canals to Nebraska.

The North Platte has a wide valley in Scotts Bluff County and across part of Morrill County. The valley narrows and some of the slopes become comparatively steep between the eastern part of Morrill County and Lincoln County.

Water Power of the Platte—The North Platte has not been developed for power in the irrigated country. Power might be generated at the drops and dams, but not economically because the water is run only during the irrigation season. The return canals, that is those carrying seepage water, have sufficient volume for some power. Pumpkin Creek, though a weak stream, would permit of small developments. Blue Water and Birdwood creeks have steady flows and would support a number of small developments. Wood River supports two small developments and has sufficient flow for other powers. There is a small power on Shell Creek near Schuyler. Four small powers that operated in Salt Creek have been abandoned.

There are two large irrigation and power developments from the trunk stream—one at Gothenburg, the other at Kearney. The Kearney project is now managed with the Boelus enterprise. Its water is diverted from the Platte about three miles southeast of Elm Creek and carried through a canal twenty-four miles long to the slope land west of Kearney, where it is dropped to generate electric current, and returned to the river. The Kearney company has the right to 140 second feet at the head gate. Additional water is developed from the sands, in what has been called "blue well." Part of the allotment is used for irrigation.

Fremont Canal and Power Project—It would be possible to locate and develop power projects in the Platte below the junction with the Loup. Two proposed projects have received considerable attention. They are known as the Fremont Canal and Power Company, and the Ross. The first named of these proposed to divert from the south side of the Platte, southeast of Schuyler, and to build a canal about 30 miles long, across the bottom land, bluffs and upland to a reservoir site east of Cedar Bluffs. A grant was made to promoters of this project. It was for 2,000 second feet and a development of about 34,000 horse power was proposed under a head of 150 feet.

The Ross Project plans to take out on the east side of the Platte, southeast of Yutan, and from the Elkhorn south of Waterloo. A proposed canal was surveyed across the bench at Melia and upon the bluffs and hills near the State Fish Hatcheries across the river from South Bend. The grant was for three thousand second feet and a proposed development of 10,000 to 15,000 horse power under a head of 70 feet. The total theoretical horse power would be about 23,868 horse power. There has been some work on this project.

Just what may be accomplished with the Loup-Platte projects is not known. The amount of power possible is more than could be utilized under present conditions. The promoters of these projects encounter a number of difficulties, some legal and others industrial and financial.

The Republican River heads on the table land of Colorado, enters Nebraska in Dundy County and flows eastward to Nuckolls County where it turns southward to Kansas. The river occupies a prairie land, and agricultural areas in Nebraska. The valley is comparatively narrow and between 200 and 400 feet deep. The valley floor is divided between the flood plain proper and well defined benches. The slope land is gradual to rough with stone exposed at places. The soil ranges between sandy loam and silt loam, but shows small area of clay loam.

The Republican is joined by a number of spring-fed streams issuing from sand beds below the loess. These streams are quite uniform in discharge. They are used for stock water, rural and town supply, irrigation and some for power.

The principal tributary of the Republican is the Frenchman in which are six powers, and much water is drawn for irrigation. Medicine Creek has successful powers at Maywood and Cambridge. The Beaver-Sappa has been used for power at two places. Small streams near Bloomington, and Red Cloud are developed for power.

Powers were installed and operated at Orleans and Red Cloud until torn out by high waters. A project at Superior develops about 200 horse power.

The Republican fluctuates markedly between low and high stages. The flow may cease at places during periods of drouth. Floods and ice gorges do some damage. A considerable acreage is irrigated from canals. Probably the largest single area is under the McCook ditch, which diverts four and one-half miles east of Culbertson and covers about 10,000 acres of which more than half is irrigated.

The Little Blue heads in the loess plains near Hastings and flows southeastward, leaving Nebraska in the southern part of Jefferson County. It unites with the Big Blue at Blue Rapids, Kansas, Which joins the Kansas River near Manhattan. The valley in Nebraska is bordered by gradual slopes in the upper course and stony land in the vicinity of Steele. The slope land soils range between silt loam and sandy loam. The river bed is strewn with sand. The stream is quite swift and is used for stock and park purposes. The normal flow is 250 to 500 second feet in the southern part of the state, but this is greatly increased at flood stage. Powers are operated at Oak, Hebron, Deweese, Alexandria, and Fairbury. Small powers have been abandoned at Blue Bluffs and Steele.

The Big Blue rises in the loess plains and drift hills south of the Platte and flows southward to Kansas. The principal branches come in from the west where they are fed by seepage from the underflow of the loess plains. The trunk stream is comparatively uniform. Its normal discharge is about 450 second feet at the state line.

The Big Blue is Nebraska's best developed power stream. There are powers at Staplehurst, Seward, Milford, below Milford, at Crete. DeWitt, Beatrice, Holmesville, and Blue Springs, and in some of the tributary streams. A power is building near Wilber and one is to be installed at Barneston.

CONSERVATION OF WATER POWER

Conservation does not permit waste. It is development for the most beneficial use. Thus far, much of the water of the state has gone to waste. This should not continue, for Nebraska has little fuel except what is shipped in. The state is rich in agriculture, but relatively weak in manufactures and commerce. Knowing this, we should realize that greater effort must be made for an all-around development. Industry follows cheap power and the state has water resources with which to develop power.

Certain advancements of recent years make possible the utilization of rivers like the Niobrara, Loup and lower Platte. They are concrete construction, canalization and long distance transmission. These conditions enhance the water power possibilities. It should be recognized, however, that most of our streams are too small for use in long distance transmission. They are better suited for local use, and there is

small demand for power at the most advantageous places for development.

The conservation of the Loup and the lower Platte deserves attention at this time. These rivers are quite well located with respect to the state's largest cities. The power, if developed, could be carried to an urban population of fully 350,000 people. It could be used to light both city and country, to drive the machinery of certain industries, and to draw the cars of city and interurban railways. These things are desirable and attainable, but there is lack of agreement regarding methods of development. Policies are being advocated and the public is interested in the matter only in a general way. Those who administer the law and all who have anything to do with the subject receive more or less criticism, whether justly so or not. The discussion is from two points of view—of the state and of private interests. This makes it especially interesting in politics. In fact, there has been too much political talk regarding the water power possibilities of Nebraska. It would seem that it is time to shift from the political discussion, and that the problem of water power should be considered in its proper relation to industry and the public welfare, and more upon a fact basis. No doubt the discussion will continue. Additional legislation will be enacted and the subject may come before the Constitutional Convention, but if this is done, it will require careful handling. Otherwise, the effect may be to retard the conservation or development of water power.

Evidently the state should have the right to develop water powers, but not for the purpose of preventing development by others, who under the statutes, would be subject to state regulation and control, and whose property, when developed, would be subject to taxation. Let the state have the right which must not be abused, and let other interests have the right under state regulation and control. This will be fair to all under good administration.

WILD LIFE RESOURCES

This group of natural assets receives too little attention. The only policy for several years, if it can be called such, has been to destroy the wild life without regard to consequence. The time has come, however, when wanton destruction should cease that progress may be made along lines determined by technical knowledge.

The destruction of certain kinds of wild life means waste which cannot be replaced with domesticated forms. There are in Nebraska a number of animals which serve continually and successfully and which the people destroy without regard to their usefulness. They are the animals which keep down insects, mice, gophers, and rats. Most of the song birds, the quail, several of the hawks, the owls, toads, bats, and some of the snakes assist in maintaining a condition necessary for agricultural development. Among the wild life resources, aside from the animals which maintain the biological balance, are grasses, forest, fruit, fish, game, and fur-bearing animals.

WILD GRASS RESOURCES

By RAYMOND J. POOL,
Professor of Botany, The University of Nebraska.

When white men first saw the area now included in the state of Nebraska, the landscape was dominated by a vast, rolling stretch of native grassland, whereas today much of the state, and particularly the eastern part, is farmed and it is difficult to find a piece of prairie in the agricultural sections large enough to give one a fair idea of the original conditions. Large areas of prairie occur, however, in the central and western counties.

Prairie a Resource—Wherever the prairie sod is broken and the soil cultivated for a few years the wild native grasses and other native plants disappear. Those which remain are to be found only along the fences and the roadsides. We would not deplore this destruction of the original prairie vegetation because of the important agricultural pursuits which have been developed by the pioneers and their descendants. But the high price of meat directs the thoughts of a larger proportion of our people than ever before to the question of meat production and to the circumstances immediately surrounding the live stock industry.

Enormous supplies of essential food products are being produced by the herds of live stock which thrive upon the native forage of the remaining grazing land, but days of the open range are past and the stock raising industries are rapidly becoming more highly specialized as is farming in general.

Much of the natural grazing land of western Nebraska has come into the hands of large operators, who face the problems of efficient ranch management. This brings them to a consideration of native and introduced pasture plants and the best methods of handling the same. Much of the grazing country is covered by the finest natural forage, yet considerable areas of it go to waste every summer, while some also is abused and destroyed by over-grazing. Most of the natural grazing land is in the Sandhill Region which is admirably adapted by nature for cattle raising. It is my firm belief after having studied all parts of the Sandhill Region for many years that vast expanses of that area can be improved and made to yield a much larger crop of beef.

Many Grasses in Nebraska—The natural forage problem is largely one of native grasses and how to utilize them. Some lands of central and western Nebraska are peculiarly rich in the number and value of grasses and other forage plants, including many species of sedges, which resemble true grasses so closely that few people distinguish them from the grasses.

Nutritious Grasses—The two most nutritious grasses of the whole list are Buffalo Grass and Blue Grama Grass. These are wide spread and abundant on the hard land of the central and western counties where they form a dense sod. The Sand Grama is quite common on sandy soil throughout the Sandhill Region. The above grasses are not only fine for summer forage, but they may also afford winter pasture. I have seen hundreds of acres covered with a fine stand of these grasses that were not being pastured at all, a condition which should not obtain where the price of meat is so high.

The Buffalo and Grama grasses are low, densely growing forms quite different from the tall prairie grasses which once dominated eastern Nebraska and which prevail at the present time in the sandhills. There are about 125 species of grasses growing in the sandhills, among which the following are prominent: Little Blue Stem, Turkey-foot Grass, Indian Millet, Sheep Fescue, Poverty Grass, Redfield's Grass, Blow-out Grass, Sand Grass, Prairie Grass, Low Blow-out Grass, and Triple Awn Grass.

Almost without exception the grasses in the foregoing list are coarse and more or less tough and wiry forms growing in upland sites which afford very poor forage during ordinary seasons, but are important in holding the soil firmly.

The blow-out grasses are absolutely useless as forage plants. Bunch-grass is another species which is poor from the standpoint of forage or food value, but it also aids in preventing the blowing of the sand. When this grass is killed out by over-grazing, fire, etc., the range becomes of low value in a very few years unless it is protected and

managed in such a manner as to allow the coming back of the valuable pasture plants.

Hay Grasses—The grasses in the following list are the most common species found in the hay meadows and over the low hills where the bulk of the hay is mowed: Wild Rye, Dennett Grass, Wheat Grass, Slender Wheat Grass, Couch Grass, Eaton's Grass, Prairie June Grass, Tall Grama Grass, Yellow Top, Tickle Grass, Alkali Grass, Prairie Grass, Muhlenberg's Grass, Needle Grass, Low Needle Grass, Big Blue Stem, Hall's Blue Stem, Switch Grass, Ribbon Grass, Cord Grass, Little Cord Grass, Indian Grass, Squirreltail Grass, and Salt Grass.

The most of these grasses are included in the hay that is made in the sandhills every summer. Practically all of them possess high food values so that the hay makes excellent winter feed.

Management of Pasture Land—Nebraska has spent thousands of dollars in the effort to improve methods of grain farming, but very little has been done to discover the most efficient system of management for the millions of acres of natural pasture lands. This important problem should be attacked in a careful, scientific manner. We ought to find out precisely how to get maximum yields of beef from the ranches. Of course many of the big cattlemen feel that they know these things already, as many of the best farmers think that they handle their farms most efficiently, but obvious mistakes are numerous and I am sure that the former would profit greatly, as have the latter, by attacking some of their problems, in technical manner in company with men familiar with the plants of the range, with their life and peculiarities, as well as with their forage values.

I have purposely avoided any reference to the promising possibilities of supplementing the natural forage of the sandhills by the introduction of alfalfa and sweet clover. I have merely commented briefly upon some of the points bearing upon the fact that the sandhills afford one of the richest, natural, cattle ranges in the world. These ranges should be managed under a system which would yield the maximum returns of the finest products in never-diminishing quantities. In other words, the fundamental principles of conservation ought to be applied to the management of this natural resource. The same principles might also be applied with great benefit in the care of small pastures connected with the ordinary farms of eastern Nebraska.

FOREST RESOURCES

By G. E. CONDRA,
Director, Conservation and Soil Survey

Nebraska has more forest, native and planted, than is generally supposed. The natural forest occurs along streams, on rough lands bordering valleys, and on the rough uplands of the western and northwestern counties. The distribution is scattered and there are no exclusively forested areas.

Broad-leaf Trees—The principal trees of valley bottoms are willows, cottonwoods, elms, hackberry, boxelder, and green ash.

Willows are represented by a number of species, of which the sandbar, black, almond-leaf, and glossy forms are the most common.

Cottonwoods are widely distributed. The broad-leaf form has the greatest range; the lance-leaf form is in some of the canyons of Pine Ridge and Wildcat Ridge, and the western or narrow-leaf cottonwood is reported in Banner County.

Elms are represented principally by the white elm and the red elm, but the cork elm has limited distribution.

Hackberry occurs on most of the alluvial lands of the state in association with elms, cottonwoods, and other broad-leaf species.

The *boxelder* is one of the principal stream-side trees of the state. It is quite plentiful in most of the bottom land forest, and leads in numbers at many places.

Green and red ash are common in many valleys in association with boxelder and other trees, but the white ash is restricted to the lowlands of the eastern counties.

The *soft maple* grows on the lowlands of counties bordering or near the Missouri, and the hard maple is found in some planted groves.

The *sycamore* is represented on the alluvial lands of the Missouri and its tributaries from Omaha southward. There are only a few trees.

The *honey locust* and the Kentucky coffee tree are found in the natural forest along the Missouri and the lower course of the Niobrara, and the former occurs also in the lower part of the Republican Valley.

The *buckeye* is in the extreme southeast corner of the state.

The *blufflands* of the eastern counties support oaks, bass wood, hickories, and a few other trees.

The *oaks* are represented principally by the red oak and the bur oak, the latter having wide range on the rough valley sides of the eastern, southern, and northern parts of the state. Some of the best

stands are in the Niobrara and its tributaries, as at Wood Lake, Long Pine, and Valentine. This tree is in practically pure stands at some of these places. The black oak, scarlet oak, white oak, swamp white oak, chestnut oak, and the black jack oak have been identified in the southeastern corner of the state.

Hickories are represented by four species, but the shell bark and bitternut are most common. They occur on the flood plains and rough lands bordering valleys of the southeastern counties.

Mountain maple, black birch, and a few representatives of quaking aspen occur in the canyons of Pine Ridge.

The *paper birch* grows on some of the steep slopes of the Niobrara Valley, the best stands being about ten miles east of Valentine.

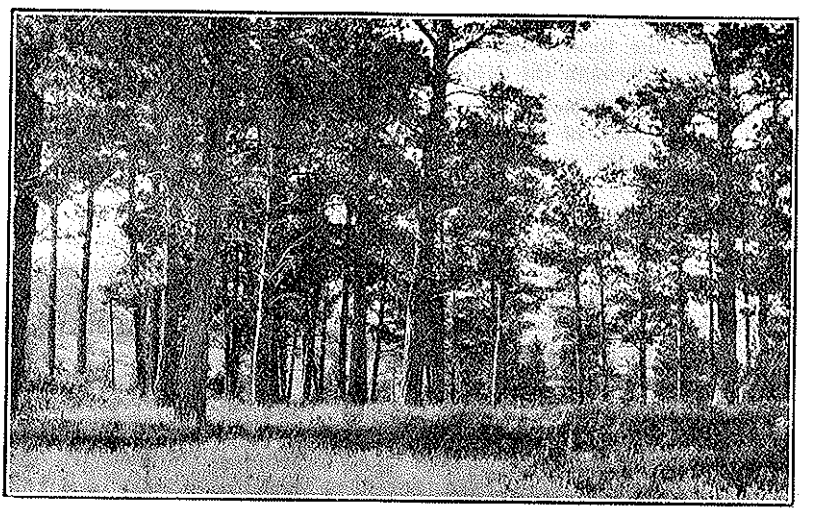


Figure 11. Pine Ridge Pines, Dawes County.

Pines and Cedars—Pines occur at a number of places in the western part of the state. Growing among the pines are red cedar and a few junipers. Most pines occur in the Pine Ridge (Figure 11), Wildcat Ridge, North Platte and Lodge Pole areas, occupying about 500 square miles. The trees are at their best on Pine Ridge, being 12 to 24 inches in diameter and 40 feet or more high. The trees are quite free from disease and the timber is of good quality. Pines are also found in good stands along the Niobrara, as in Schlagle Canyon south of Valentine, north of Ainsworth, and in Long Pine Canyon. The broad-leaf species of the east and the pines and cedars from the west meet along the Niobrara.

Tree Planting—Nebraska is the home of Arbor Day. There was a great deal of planting during tree-claim days and favorable results have been attained in every soil province of the state. Planted groves occur throughout the lengths of the Republican, Platte, Lodgepole, Loup, and Elkhorn valleys. They have made rapid growth during recent years and great credit is due the tree planters of Nebraska. The early planters used the trees they could secure, such as cottonwood, ash, boxelder, locust and catalpa, and relatively few pines and cedars. Fires and cattle did much damage to the groves and few trees were irrigated.

Forest Reserves—The federal government has experimented with tree planting near Halsey and shown conclusively that certain species can be grown on the sandhills of Nebraska. Many ranchmen, profiting by this experience, have beautified their places and grown large wind breaks for protection. The Reserve now has several hundred acres of very good pine forest which can be seen from the Burlington trains as they pass through the Middle Loup Valley above Halsey.

Amount of Timber—Some counties of the state appear to have only about 1 per cent of forest area whereas others, such as Thurston, Lancaster, and Dawes, have 7 per cent or more. Between 3 and 4 per cent of the state is covered with trees including natural and planted timber. It is thought that the number of acres of trees is about equal to the number of people in the state. This is timber enough, if used for fuel, to support the state during a coal famine if one should ever come. Persons wishing reports on the trees and the timber of Nebraska should write the Conservation and Soil Survey at The University of Nebraska for Bulletins 7 and 13.

Use of Trees—The forests of the state have not been used economically. The bur oak leads the broad-leaf trees in value. It is used chiefly for posts. The cottonwood is used for wind-breaks, fire wood, and lumber. The walnut has high value for lumber. Willows are used for fire wood and rip-rap. Ash, boxelder, maple, most oaks, and bass wood are used for structure purposes but mostly for firewood. The yellow pine is used for posts, poles, ties, and lumber. Red cedar, osage and catalpa serve well for posts.

Conservation Problems—The utilization of forest is a problem in Nebraska. Trees occur in mixed stands and there is no definite market for their products. The people do not understand the use of the axe and the saw. Fire wood has little demand because coal is used generally. Lumber comes from other states and it will not be possible to produce lumber in Nebraska in competition with the large lumber districts and their methods of distribution. Trees are used in Nebraska mostly for windbreaks, and parking purposes for which the selection of species has not been very good. Also the trees have received little care and will require much effort to repair the trees of Nebraska's parks, streets and lawns.

WILD FRUITS

By G. E. CONDRA,
Director, Conservation and Soil Survey.

The wild fruits of most importance in Nebraska are gooseberries, raspberries, blackberries, currants, grapes, chokecherries, and the sand cherry, plum, buffalo berry, crab apple, elderberry, and pawpaw.

The Common Gooseberry is on most of the bottom lands of the eastern and southeastern parts of the state where there is forest. It comes

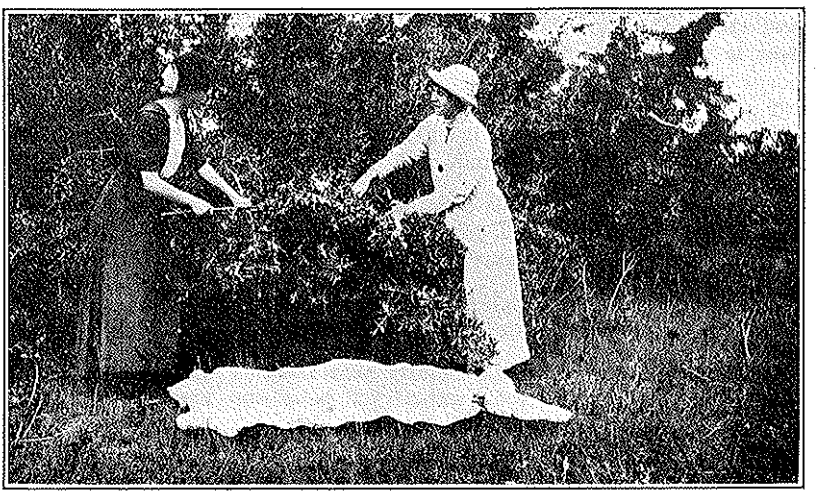


Figure 12. Gathering Buffalo Berries along the North Platte.

into fruitage early in the year and the fruit is eagerly sought by many people from the country and towns. The western wild gooseberry is found principally in the northwestern counties. The red raspberry and the black raspberry are found on the slope lands of the timber belts. They give a limited amount of food. The wild currant is quite plentiful at places in the canyons of the Pine Ridge and Niobrara areas. It also occurs in the ravines bordering the North Platte.

Wild Grapes of two kinds occur in the state, being found in practically every county with timber. They are the early wild grape and the summer grape. The fruit of these has considerable value especially along the Missouri and in the Frenchman and Niobrara valleys.

Wild Cherries of four species grow in Nebraska. They are the wild black cherry of the eastern counties, the sand cherry of the sandhills, the western chokecherry and the common chokecherry.

The Sand Cherry is a valuable fruit. It grows on very sandy ground, principally on the sand hills and at places on the high plains of western Nebraska. The ranchmen gather this fruit in large quantities and use it for a number of purposes as for jelly, jams, sauce, and wine.

Chokecherries are widely distributed in the state. The western form produces large amounts of fruit, which are used for jellies, butter and other purposes. The chokecherry is a common plant along the Niobrara and its tributaries, in the canyons of the Pine Ridge, along parts of the Platte, and at places in the Loup and Elkhorn valleys.

The Buffalo Berry, sometimes called the bull berry, grows along most streams and ravines of the western and central counties. The plant is a strong branching shrub, three to eight feet high, and with thorns and light colored leaves. The fruit is reddish when ripe. Probably most fruit of this kind is produced in the North Platte Valley on sandy land near the river (Figure 12). The fruit is gathered in large quantities late in the fall and used principally for jellies and jams.

The Wild Plum has wide distribution in Nebraska. It is especially abundant in the Frenchman, Medicine and Niobrara valleys. The fruit is used for butter and sauce.

The Western Crab Apple is present, but not plentiful in the state, occurring principally in the southeastern counties.

The Elderberry grows abundantly near streams in the southeastern counties. It is used to some extent for jams and preserves.

The Pawpaw grows along the Missouri in the southeastern part of the state. It is most plentiful at or near Nebraska City, Peru, Brownville, Nemaha and Rulo. The ripe fruit is eaten raw.

Nuts grow in parts of Nebraska. Hazel nuts occur in some of the timber areas of the southeastern counties. The hickory nut is found in this part of the state and the black walnut is more widely distributed.

FISH RESOURCES

By G. E. CONDRA,
Director, Conservation and Soil Survey.

Nebraska has several kinds of fish in small streams, rivers, natural lakes, and artificial lakes. The following are the principal kinds: Channel cat, bullhead, crappie, pike, perch, trout, sunfish, carp and buffalo.

A subdivision of the State Department of Agriculture looks after the propagation, distribution and protection of fish, licensing and the enforcement of fish and game laws. There are three state fish hatcheries in Nebraska. A chief game warden and many deputy wardens are employed to conserve the fish resources of the state.

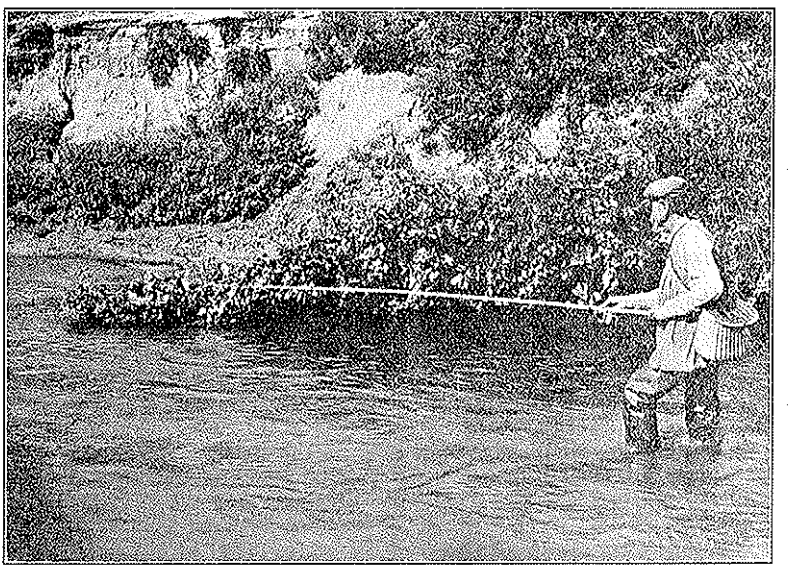


Figure 13. Mr. George Lamb, trout fishing in Long Pine Creek, Brown County.

Speckled and Rainbow Trout occur in many of the small, swift streams of the northwestern part of the state, as in the Pine Ridge area and in tributaries of the middle course of the Niobrara (Figure 13). Some of the trout streams are Monroe Creek, Sow Belly Creek, West Hat Creek, East Hat Creek, White River, Big Bordeaux, White Clay, Boardman, above its junction with the Snake, Schlagle, Minnechaduza, McFarland and Plum creeks. Trout occur also in the drainage ditches of the North Platte Valley and at the head waters of the Elkhorn and Loup rivers. One can find very good sport among the trout of Nebraska.

Bass of different kinds, of which the big-mouthed species is the most representative, grow in several natural and artificial lakes throughout the state and fishing is very good at some of these places. At one time bass fishing was best in some of the sandhill lakes. Most fish here were winter-killed in 1915. Lakes were again stocked and fishing has become quite good. Beaver, Rat, Hackberry, Red Deer, Dewey, Willow, Enders, and Center lakes are well-known bass lakes. Willow Lake is the best bass breeding ground in the state. Bass and perch minnows are collected here for stocking other waters. There are bass in the dredged lakes along the Platte, in a number of cut off lakes along the Missouri and Republican, in artificial lakes of the Loup, Elkhorn and Niobrara valleys and in some of the reservoirs of the irrigation districts.

Blue Gills, Sunfish and Crappie occur in most waters suitable for bass and perch. Some of the largest catches of crappie and sunfish are from dredged lakes near Fremont, Valley, Ashland, Meadow and Louisville.

Striped Perch are present in great numbers in Dewey, Red Deer, Hackberry and several other lakes of Cherry County. They occur also in many natural lakes, artificial lakes and reservoirs, and in some streams. This fish is well suited to Nebraska and is easily caught. Its firm meat makes good eating.

Pickerel and Wall-eyed Pike grow principally in the Niobrara and North Platte, but are found in the Loup, Elkhorn and Republican, and several lakes. Large numbers of pike are caught below the diversion dams in Scotts Bluff County. The catch each year is equal to many tons. The pike has been planted in several streams and lakes.

Bullheads are common in Nebraska, in the streams, ponds and lakes. The yellow cat is a desirable fish. It has been distributed quite generally for stocking purposes.

Channel Cats are in all rivers of the state. They afford good fishing in the Republican, Little Blue, Nemahas, Loup, Elkhorn and Niobrara, and at places in the Platte. They are also found in many lakes.

German Carp, American Carp and Buffalo are found in many streams and lakes. The carp are caught mainly in the southeastern part of the state. The buffalo is widely distributed, occurring in practically all streams of the western counties. Gar and sturgeon are large stream fish. They occur principally in the Missouri and Platte. The eel has been caught in the Elkhorn, Loup, and Platte.

Frogs have some importance as a source of food. The small leopard frog thrives in most marshes and fresh water lakes. Though edible, it is not much used for food. The greenish bullfrog is native to the

southeastern counties. Many of the streams and lakes in the central and northwestern counties have been stocked with this frog. One of the best results obtained is in the boggy places of Long Pine Canyon. Frogs, now quite numerous in these places, are becoming of value for food.

Turtles occur in all parts of the state in both dry and wet places. The snapping turtle is widely represented by a number of varieties. Some of these are too small to supply meat. A very large edible form grows in the fresh-water lakes of the sandhills. As much as twelve pounds of meat has been taken from a single animal. This meat is used for soups and stews. The soft-shelled turtle is found in a number of streams in the southern and southeastern parts of the state and occasionally in the streams and lakes of counties farther northwest.

GAME RESOURCES

By G. E. CONDRA,
Director, Conservation and Soil Survey.

The state's game consists of birds and mammals. Among the birds are the quail, grouse, prairie chicken, ducks, geese, snipes, plovers, and the curlew. The wild turkey was formerly found in the eastern and southwestern parts of the state. The mammals are the rabbits, raccoon, antelopes, and deer.

Bob White or Quail occur in parts of the state where there is brush and timber. They are quite numerous along the Niobrara and parts of the Republican and are among the best game birds of the state, but have greater value in agriculture. There is no open season on quail at this time.

Prairie Chickens were formerly plentiful in the eastern and southern counties. There are few birds now except in the eastern part of the Sandhill Region (Figure 14). Grouse occur in the sandhills, mostly in the central and western parts. They are closely related to the prairie chicken, but the feet are feathered whereas the feet of the prairie chicken are bare. Grouse are much lighter below and this is particularly noticeable in flight. The prairie chicken flies less smoothly than the grouse. Both birds afford good shooting in the sandhills. Sage hens are not now found in Nebraska, but they do occur across the line in Wyoming.

Ducks are in Nebraska in large numbers during periods of migration and breeding (Figure 15). Some of them remain during the winter. Those breeding, principally in the lake districts of the sandhills are: Blue-winged Teal, Green-winged Teal, Mallard, Pintail, Ruddy or Butterball, Redhead, Canvasback, Ring-necked Duck, and Shoveller.

About fifteen other ducks, six or seven species of geese, the trumpeter swan and the white pelican are migrants.

Federal Laws—The federal laws which prevent spring shooting seem to be working favorably in conserving the migrating bird resources of the state. The number of ducks nesting here is noticeably on the increase.

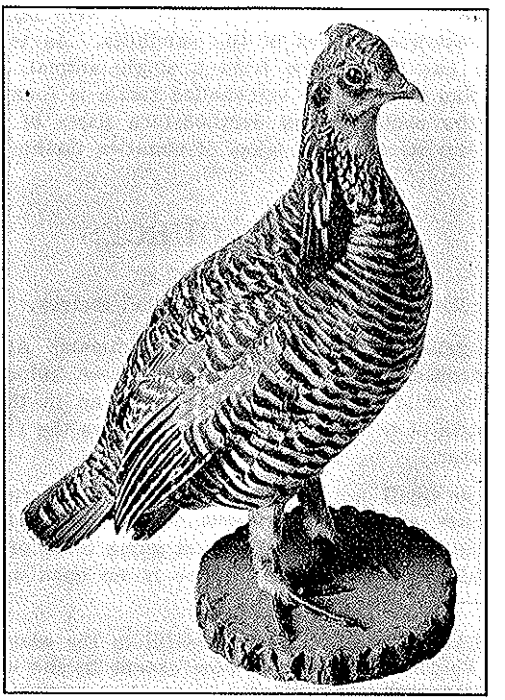


Figure 14. Prairie Chicken. In collection of August Eiche of Lincoln.

Hunting Ducks and Grouse—Duck and grouse shooting have considerable importance in parts of the sandhills. There are lodges or hunting camps at many lakes and marshes. The number of birds killed at these places during the open season is large. Hunters come from all parts of Nebraska and from other states. Duck shooting is very good in other parts of the state, and a number of geese are bagged each year.

The Upland Plover formerly was plentiful throughout the state. The numbers dwindled until a few birds were observed, since which time there has been a steady increase.

The Jack-snipe or Wilson's Snipe is found in small numbers about marsh land, but seems to be decreasing as these areas are drained.

The Long-billed Curlew has increased in numbers the past few years. It occurs throughout western Nebraska but principally in the wet valleys of the sandhills. There is no open season on this bird in the state.

Shore birds and the Mourning Dove are hunted some in Nebraska. The dove receives natural protection in that many people are opposed to killing it on account of sentiment. There is no open season on the dove.

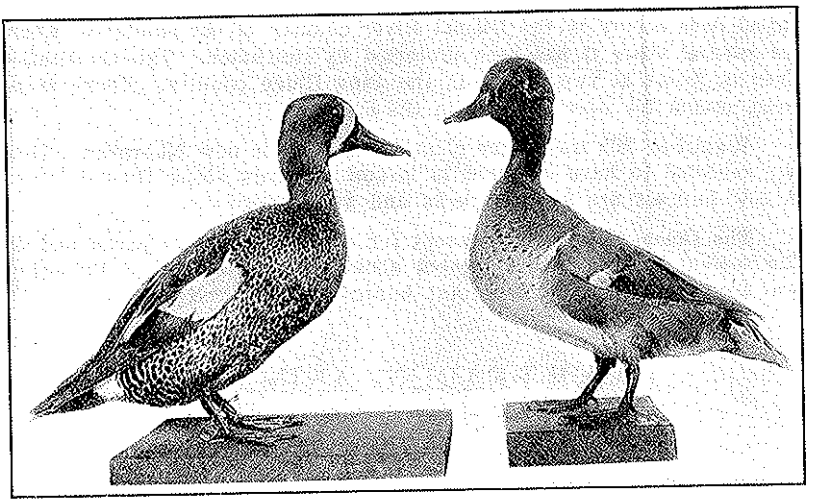


Figure 15. ..Blue-winged Teal (left) and Green-winged Teal (right). In collection of August Eiche, Lincoln.

The Chinese Pheasant has been introduced at places in the state. If the bird is as successful here as it is in Colorado, it should become a source of food within a few years.

Rabbits are common in all parts of Nebraska. There are four species—the prairie cottontail, common in the eastern counties; plains cottontail of the western part; the black-tailed jack rabbit, principally in the southern counties; and the white-tailed jack rabbit, mainly in the northern part of the state.

The rabbits are hunted universally. They afford sport and supply a considerable amount of meat. It would be possible to further develop them as a resource.

The Western Fox Squirrel occurs in native timber in eastern and southeastern counties. It is also found in planted groves in most parts of the state. The squirrel is hunted to some extent for meat.

The Raccoon occurs along practically all streams in the state, especially where there is brush, and about the marshes of the sandhills. It is hunted very generally in wooded areas and is trapped in the lake districts. The opossum occurs in the timber belts and is found occasionally a considerable distance from forests.

The Prong-horn Antelope, once plentiful in all parts of the state, remains in Kimball, Banner, Sioux, and Garden counties. The largest bands are in Sioux county, south of Agate, and in Garden county, near Crescent Lake. The antelope is protected throughout the year.

Deer of two species remain in northwestern Nebraska. The white-tailed deer occurs in the Dismal River country of the sandhills, where for several years it has been protected by ranchmen. The black-tailed deer is found at two places in the Pine Ridge country. There is no open season for deer hunting in the state.

Wapiti or Elk were very plentiful in what is now Nebraska. They are reported to have occurred in largest numbers along Dismal River. A few animals are now in parks and game preserves.

The Bison, now extinct except for a few animals in parks and on the federal game preserve located about four miles east of Valentine, was formerly the most important hunted animal in Nebraska.

FUR-BEARING ANIMALS

By FRANK H. SHOEMAKER,
Of the Conservation and Soil Survey.

The largest fur-bearing animals found in Nebraska at the present time are the beaver, raccoon, badger, lynx, bobcat, and coyote. Smaller animals with furs of value are the muskrat and the various species of skunks, weasels, and minks. Formerly the black bear, the wolverine, the marten, and the otter occurred more or less commonly in Nebraska, but all are now extinct within our borders, excepting possibly the otter.

Muskrats, by reason of their numbers, are probably of the greatest economic importance in Nebraska as fur producers. They occur in all parts of the state along streams and lakes, ponds and marshes, sometimes in large colonies. Considerable trapping is done, chiefly in the western part of the state and about sandhill marshes, and with good returns. The raising of muskrats for furs might be greatly developed there, as it has been in some states farther east.

Minks, Weasels and Skunks are found chiefly in woodland along streams. Their furs are highly valued if taken at proper seasons. These animals are all destructive to poultry, and for protective if no other reason, should be trapped systematically where poultry is threat-

ened. The game laws provide that such trapping may be done without a license. For general trapping, however, a license is required, at a cost of $2 to residents and $10 to non-residents per annum.

Fur Farming might be taken up profitably in various parts of the state. Some of the native animals mentioned could be raised to advantage. In some eastern states foxes and other animals are raised for furs, and it would appear that the Pine Ridge area of Nebraska is favorable to the development of such an enterprise.

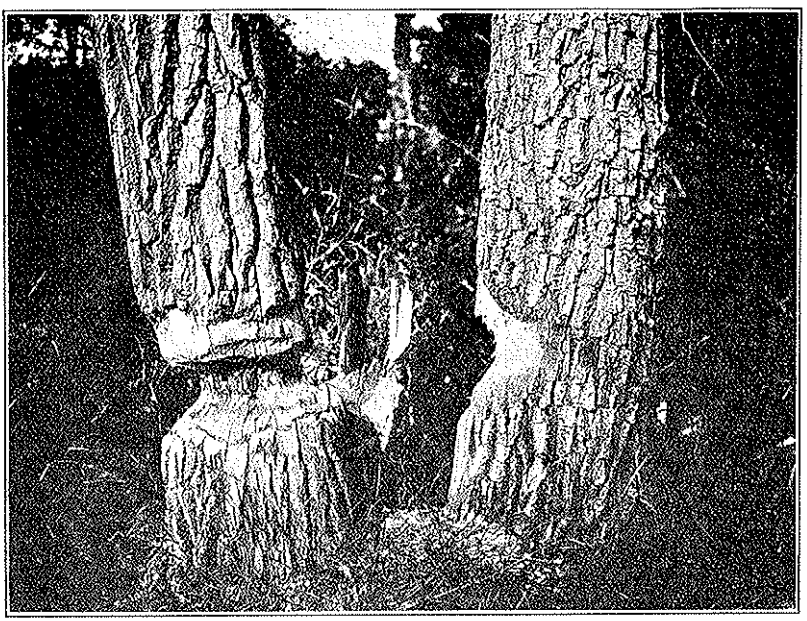


Figure 15a. Beaver work in a canyon of the Pine Ridge Region.

AGRICULTURAL NEBRASKA

Nebraska is rich in agricultural resources, development and possibilities. Much of the agriculture has passed the experimental stage. It is more or less specialized and standardized. Land values average higher than in most states. There are no public lands subject to entry. Everything, except tracts of a few acres each, is deeded and managed as ranches and farms.

Rich Heritage—The deep, fertile soils of Nebraska represent a heritage of great value. Though there are more than 100 kinds of soil, much of the land is stone free. Broad stretches of comparatively smooth country have a subsoil 50 to 100 feet deep and as rich as the surface soil except for the lower percent of humus. Such large areas of this kind are not found in any other state.

The diversity of soils, topography, and rainfall in Nebraska cause a diversified agriculture. They determine the distribution of grazing, dry farming, irrigation, and humid farming.

Nebraska ranches and farms are well improved. Most of them use machinery and motor power. There is more than average efficiency per unit of labor. In other words, the percapita production is high.

Farmers' Organizations—The various branches of agricultural industry are organized to further production and distribution. For example, there are Swine Breeders, Livestock Associations, Dairy Organizations, Corn Growers and Fruit Growers, representing specialized industry, and the more general organizations, such as the Farmers Congress, Farmers Union, etc.

Farm Papers—The daily press, farm journals, and other publications are found in every country home. The Nebraska Press Association is furthering conservation and state development (Figure 16).

The following articles by competent persons cover the leading agricultural industries of Nebraska.

THE CORN INDUSTRY

By W. W. BURR,
Professor of Agronomy, The University of Nebraska.

Importance of Corn—Corn is Nebraska's principal crop, being grown on about one-half of the cultivated area of the state. In fact, the favorable climate and good soil make the state especially adapted to corn growing (Figure 17). The cash value and acreage of corn is more than the total of wheat, oats, rye, and barley. Since 1910 the corn acreage has increased slightly. The acreage in 1910 was 6,595,088, while in 1918 it was 6,954,061 acres. In 1918 however, the total yield was 123,298,649

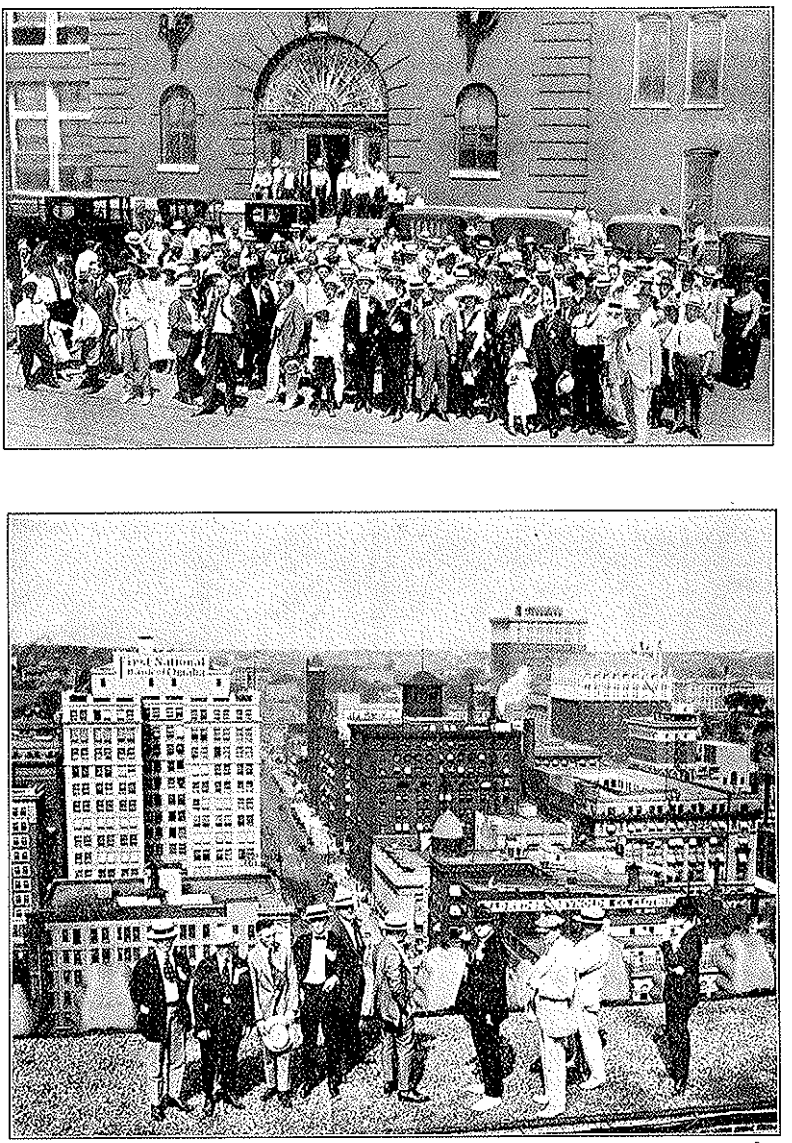


Figure 16. The Nebraska Press Association at the Omaha Livestock Exchange (above) and looking across Omaha (below). This association made a special train excursion through Nebraska in 1919 to study the resources, industries, and development.

bushels, while in 1910 with a smaller acreage the yield was 178,923,128 bushels. This decrease in yield in 1918 was due largely to the low rainfall. The total value of the crop in 1918 was $160,288,243, as contrasted with $87,877,546, in 1910. The total acreage in 1919 was 7,639,811 with a production of 182,250,823 bushels valued at $227,813,528.75. War time prices have brought unusual prosperity to the corngrowers of the state.

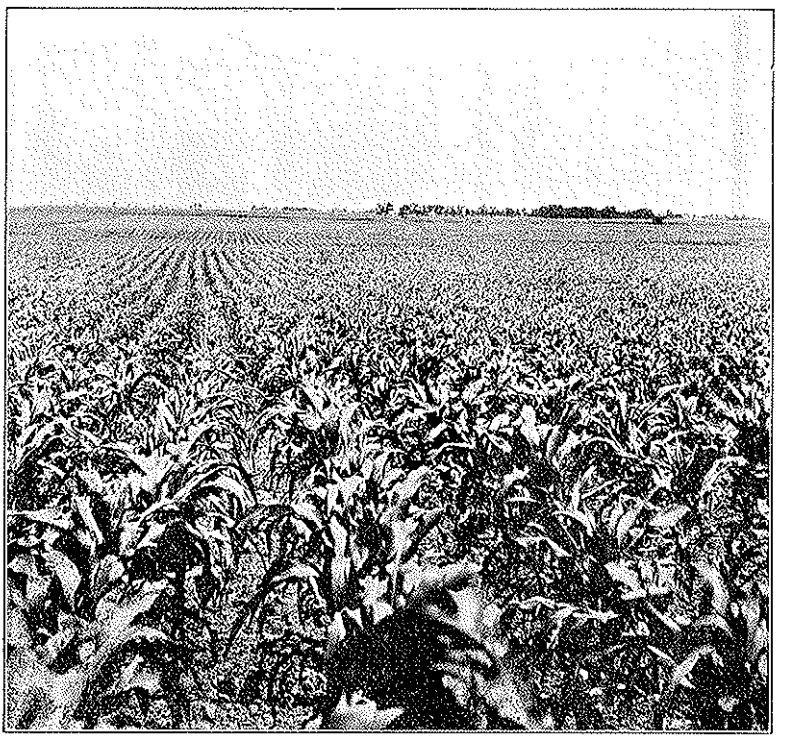


Figure 17. One of Nebraska's many cornfields.

Varieties—The common varieties for the southeastern parts of the state are Reid's Yellow Dent, Hogue's Yellow Dent, Chase's White Dent, Iowa's Silver Mine, St. Charles White, and corns of that type. The ears grow 8 to 10 inches long and 7 inches in circumference. The kernels are rather deeply indented, have rather distinct keystone shape and are starchy.

For the central parts of the state, modifications of the above varieties as well as Calico and Gund's White are grown. The ears are 7

to 9 inches long and not as large in circumference nor with kernels as deeply indented as those in the eastern counties.

The varieties in western Nebraska are Calico, Martin's White Dent, Minnesota 13, and Pride of the North. The ears are 6 to 8 inches long and small in circumference with kernels smooth, shallow and almost round, and of flinty nature.

Sweet corn and pop corn are grown for local and commercial purposes at a number of places in the state.

Locally Adapted Seed—The seed corn supply is usually furnished by some one in the community who makes seed production his business. In the early development of western Nebraska many failures were due to attempts to grow unadapted varieties. Corn from Indiana, where the growing season is long, barely reached the milk stage when grown at North Platte, Nebraska.

Soils and Rotation—The rich alluvial soils of the river bottom lands are almost ideal for corn growing, yet the crop is widely grown on upland soils. Experience in Nebraska shows that in crop rotation, particularly in the more drouthy sections, corn following alfalfa, and sometimes clover, will dry out and make a very light crop for two reasons; first, alfalfa land is likely to be dry to considerable depth with no reserve moisture and second, the increased amount of available fertility stimulates more growth than the water supports.

In eastern Nebraska a legume included in the crop rotation will increase yielding during normal rainfall. Manure plowed under in this section adds fertility and opens up the soils, but in western Nebraska the application should be light and may best be used as a top dressing because if plowed under the soil, the ground does not pack well and suffers from lack of rain more readily.

Methods of Tillage—In the eastern counties the common method of preparing the seed bed is to plow the land. This may be done in the fall where the soil does not blow or wash, although corn on fall-plowed land may burn worse in case of drouth. Plowing is done in spring if the ground is too dry in fall, or if fall plowing is not best for other reasons.

In the western part of the state the soil is usually disked early in the spring and listed at time of planting. Some farmers disk in early spring and re-disk just before planting. Listing is the common method of planting, the corn being put in the bottom of an open furrow which gives the root a good depth when cultivated. This helps the corn to resist dry weather and makes it stand up against strong winds. Listing causes a soil of rolling land to wash.

In some seasons, four or five cultivations are necessary; in other seasons, two or three cultivations are sufficient. Late cultivation is not advisable unless the corn is weedy because the damage done the roots will often more than offset the good from the cultivation.

Modern machinery, including tractors and two-rowed cultivators, is used in the tillage of corn in Nebraska.

Harvesting—At the present time much corn is cut with the binder for ensilage or for stock fodder. It is estimated that the fodder of the corn crop is from 35 to 40 per cent of its total value. Feeding fodder from the silo eliminates the danger of loss from corn stalk disease.

"Hogging down" corn is becoming more common every year, not only because it saves the labor of husking but also because it is an excellent method of feeding growing shoats.

Much of the corn crop is husked, stored, and fed on farms. Some is shipped. Corn is becoming an important source of human food.

Sweet corn—In some sections of the state, especially in the southeastern part, considerable sweet corn is grown on a commercial basis. This is supplied to the canneries in those sections. Several varieties are being grown. This industry has usually brought good returns.

Pop Corn—In the central and northeastern parts of the state, pop corn is grown on a commercial basis, the rice variety being the one ordinarily grown. Under prices that have normally obtained around three cents a pound to the grower, the returns have been satisfactory. During war conditions, the price to the grower was as high as six or seven cents per pound. Some growers are putting the pop corn in cribs in order to hold and find their own markets. Previously most of the pop corn has been grown under contract.

THE WHEAT INDUSTRY

By W. W. BURR,
Professor of Agronomy, The University of Nebraska.

Acreage and Production—Next to corn, wheat is Nebraska's most important grain crop. The rapid development of the western sections of the state together with war prices has in recent years induced a large increase in acreage. From 1,000,950 acres in 1890, wheat in 1918 reached 3,827,659 acres, with a yield of 43,241,840 bushels, representing in that year a valuation of $88,483,680. Since the 80's there has been steady increase in production per acre. According to figures compiled by the U. S. Department of Agriculture, the yield per acre was 10.8 bushels, for the 10-year period from 1886 to 1896; the next 10 years 15.4 bushels and during the 10-year period from 1906 to 1915, 17.8 bushels. The average yield for the entire United States from 1907 to 1915 was 15 bushels per acre. The acreage in Nebraska for 1919 was 4,383,731, and the yield of 60,980,427 bushels represented a valuation of $121,675,881.10.

Winter Wheat—The increase in wheat growing after 1890 was due largely to the popularity of raising winter wheat. Prior to that time, most wheat grown in Nebraska was spring wheat, but now very little spring wheat is grown. Attempts to grow winter wheat were unsuccessful until the present Turkey Red was introduced. The most extensive wheat area of the state is south of the Platte and west of Gage and Lancaster counties. There are several important areas in the western counties. Wheat is grown in all agricultural districts of Nebraska.

Wherever winter wheat can be grown, it is more desirable than spring wheat because it gives the larger yields. Winter wheat ripens earlier, thus escaping some danger of dry weather, insects, and disease. In the eastern counties, if the weather is hot and dry, spring wheats are usually shriveled, while if the weather is moist, warm and favorable to the devolopment of rust, the crop will not properly fill. Spring wheat is most extensively grown in the northern and northwestern counties.

Varieties of Winter Wheat—The Turkey Red, Kharkov, and Beloglina or any of the Crimean wheats are well adapted and hardy. Turkey Red is far more commonly grown than any other winter wheat in the state. Marvelous, a comparatively recent variety, has given good yields but of somewhat inferior quality.

Varieties of Spring Wheat—Two distinct types of spring wheat are the Common and Durum or Macaroni. The latter does not do well in humid weather. It is adapted to a rainfall of under twenty inches. Durum is grown rather extensively in the western and northwestern parts of the state. Of the common spring wheats the Swedish, Bearded Fife, Marquis, and Early Java have given good results in Nebraska. The Swedish and Marquis are both commercial varieties and can be obtained on that basis.

Tillage—No definite system of tillage for wheat can be laid down on account of the climatic conditions. In the eastern part of the state early plowing for winter wheat has given best results. Early plowing destroys the weeds, catches the moisture, and allows time for the soil to settle before seeding. This system necessitates an intermediate crop between corn and winter wheat.

In the western part of the state the major portion of the wheat follows wheat or is seeded in the cornstalks. The less profitable intermediate crop is eliminated. Spring wheat is commonly sown following corn and the corn land is disked. Experiments at North Platte show that disking corn land is as good as plowing.

Crop Rotation—The question of crop rotation is not definitely settled. The practice of alternating corn and wheat in western Nebraska does not take into consideration the question of soil fertility. Since the land is comparatively new, soil fertility is not as important a question there as in older sections.

In the eastern part of the state the rotation is corn, one to two years, followed by oats and then wheat. On lands that have been cropped long, a legume, as clover between wheat and corn, is profitable. Where soil does not show depletion, definite rotations are not popular. Oats, the common intermediate crop between corn and wheat, have shown to be less profitable than either corn or winter wheat.

Harvest—Binders, headers, and combines are used in harvesting wheat. Binders prevail in the eastern counties. Headers are used most where the rainfall is least making short straw. A few combines, though not entirely satisfactory, are found in the table land areas of Deuel, Cheyenne, and other western counties.

Markets—Wheat is stored for a brief period on farms or it is hauled at once from threshers and combines to elevators at railroads from which it is shipped to large markets, such as Omaha, Minneapolis and Kansas City. Much wheat is milled in the state.

Other Small Grains—Oats, rye, and barley are extensively grown in Nebraska.

ALFALFA IN NEBRASKA

By R. P. CRAWFORD,
Of the Nebraska Farmer.

Alfalfa is one of Nebraska's main crops and with the exception of wheat, corn, oats, and wild hay, was credited with the greatest acreage of any crop in 1918. Reports from the State Board of Agriculture indicated 1,164,941 acres devoted to this crop in 1918 with a yield of 2,527,834 tons. The acreage in 1919 increased to 1,180,234 with a production of 3,214,999.1 tons. This shows an increase of 687, 165 tons in production for one year. Alfalfa gives the heaviest yield per acre of any hay crop grown in Nebraska.

Probably the last ten years have witnessed the greatest development in alfalfa growing in the state. In 1908 the total acreage was only a little more than a half million acres. Now there is hardly a county in the state that does not have an important acreage devoted to this crop. Through the west-central section of Nebraska there is a district that is more famed for its alfalfa than almost any other section. Last year one man sold his crop in the field, stacked but not hauled away, for $70 an acre. This is above the average and the prices received last year were unusual, but it nevertheless gives some idea of the money that lies in the growing of this crop. Another farmer, a sheep man, estimates that during normal years he can make $24 an acre net profit. That is figuring alfalfa at only $8 a ton.

While alfalfa has attained its greatest popularity in the western

half of the state, it is well suited to nearly every section and a good majority of the farms have at least some acreage devoted to it. It is easily grown and the fact that it comes up year after year makes it a crop to be managed with the minimum of care. Alfalfa also plays an important part as a soil builder. It belongs to a legume family and growing it will enrich the soil. Each acre of alfalfa adds over twice as much nitrogen to the soil as the average acre of red clover. Alfalfa because of its long root growth will also withstand dry weather much more readily than other crops.

It is advantageous in purchasing seed to buy of someone in the section in which the planting is to be done. The longer the alfalfa has been growing in the field from which the seed is secured, the less likelihood of its readily killing out. Some farmers have been fortunate enough to obtain strains which are very resistant, among such varieties being the Grimm alfalfa.

In most sections of the state it is possible to obtain three cuttings and in the more favored sections four. Much of the hay grown is kept by the owners to use for cattle feeding during the winter and probably in a fewer number of cases it is sold outright. It is increasing in popularity as pasture, especially for hogs. Large profits are also made in some farms by growing it for seed. Another important source of income for the grower of alfalfa is the alfalfa milling industry which has resulted in the establishment of mills in various sections of Nebraska. These mills turn out alfalfa products and offer a good market for the grower who desires to sell his crop outright.

Other Hay Crops—In 1918 there were 2,587,678 acres devoted to wild hay and 2,771,234 acres in 1919. During the last ten years there has been a gradual tendency, however, to devote more acres to cultivated crops, this being especially true with the development of the newer districts of the state. In 1918 there were 122,162 acres of clover, 154,472 acres of timothy, and 101,441 acres of timothy and clover mixed. In 1919 the acreage was as follows: Clover, 60,213; timothy, 46,724; timothy and clover mixed, 185,233. The yield of wild hay is far less than the yield of alfalfa. In 1918 the yield of wild hay per acre was .88 tons, while alfalfa yielded 2.1 tons, this being a low-yielding year for both crops, but in 1919 wild hay averaged 1.02 tons and alfalfa 2.7 tons. The average yield of alfalfa is close to 3 tons per acre, while the average yield of wild hay is approximately 1 ton.

THE BEET SUGAR INDUSTRY

By ESTHER S. ANDERSON,
Department of Geography, The University of Nebraska

Conditions Favorable—Nebraska is one of the pioneer states in the production of beet sugar. The climate and the soils of the western counties are especially suited for growing beets high in sugar content. The long summer days with abundance of sunshine and the cool nights are favorable conditions. The beet fields are irrigated during the growing season but little water is required later when the plants are manufacturing and storing sugar.

Where Beets are Grown—The principal beet-growing areas are in the North Platte, Platte, Lodgepole, and Republican valleys on very fine sandy loam and fine sandy loam soils. The land is comparatively smooth, well drained, and easy to till.

Sugar Factories—The first successful beet sugar factory in the United States was erected in Alvarado, California, in 1870. The second, with a capacity of 350 tons of beets per day, was built in Grand Island in 1890 by the Oxnard Brothers. This plant which has run most campaigns since building, was remodeled and enlarged last year. A factory with a capacity of 400 tons per day was built at Norfolk in 1891. It operated with indifferent success for a few years and was finally moved to Lamar, Colorado. A plant constructed at Ames, Nebraska, several years ago, operated a few campaigns and was moved to Scottsbluff where in 1910 it was built into a large modern plant with a capacity of 1,900 or more tons per day. In 1916 a factory, capacity about 1,200 tons, was erected at Gering, and the fourth plant now operating in the state was established at Bayard in 1917.

It has been found that conditions for the beet sugar industry are less favorable in the east-central part of the state than in the western part. The sugar content is lower and it is not possible to organize and conduct the labor activities so readily because the people are more accustomed to the growing of corn, wheat, and alfalfa; hence, the first factories built in Nebraska were moved to the more advantageous places.

Shipment of Beets—Beet raising has rapidly increased since the development was started in the North Platte Valley. Beets grown in the Republican and Lodgepole valleys are shipped to the Grand Island plant and to factories in Colorado. The Grand Island plant receives beets also from the Platte and lower part of the North Platte Valley. Most beets grown in the North Platte Valley are milled at the Scottsbluff, Gering, and Bayard plants. Some Wyoming beets are shipped to these factories.

Acreage and Production—The acreage of beets in the state in 1918 was 42,746, from which were harvested 470,574 tons of beets containing

a sugar content of about 16 per cent. This gave 63,596 tons, or 127,192,000 pounds of sugar for the 1918-1919 campaign which began late in September and ended in February.

Disposal of Sugar—The sugar is shipped to large warehouses in Nebraska and other states. It goes principally to Nebraska, North Dakota, South Dakota, Minnesota, Iowa, Illinois, Missouri, Oklahoma and Arkansas.

Beet Seed—Prior to the European war our country imported nearly all seed used in beet growing. This came from Germany, Russia, Belgium, and other European countries. With the beginning of the war, it became necessary to grow a domestic supply. Nebraska did her part in this respect. The seed crop of 1917 was very good. The 1918 crop was below the average, yet the production was 58,971 pounds of seed. In 1919, 107,720 pounds of cleaned seed was produced.

Labor—The raising of beets requires intensive cultivation, hence a great many people are needed, especially at the times of cultivation and harvest. A considerable amount of foreign and recently Americanized labor is employed. There is a movement every year of workers from cities, like Omaha, Lincoln, Hastings, and McCook, to the beet fields. These laborers do much of the work in blocking, thinning, cultivation, irrigation, pulling, piling, and hauling of beets. The work is done by contract at a definite price per acre. The women and children do much of the hand work and the men engage chiefly in operating the machinery.

The laborers return to the cities, as a rule, after the season's work has been completed in the beet fields, and engage in some other line during the winter when their children are in school. Some of the laborers remain in the beet districts to become land owners and beet growers.

Contracting Beets—Contracts are made between the farmers and the sugar companies for the acreage of beets to be grown and for their delivery to the factory. These contracts specify the price per ton of beets. The companies, knowing the number of acres of beets under cultivation, are able to estimate the probable tonnage to be milled at the end of the growing season. Field men are employed by the companies to secure contracts, distribute seed to the growers ,and to oversee and direct the cultivation and delivery of beets. Each factory or company has a general agricultural superintendent and a number of field men. Each field man has charge of 2,000 to 4,000 acres of beets per year.

Economic Relations—Some of the economic relations of beet raising in Nebraska are soil improvement due to fertilization; careful cultivation, and the beneficial results of growing a root crop; the production and feeding of thousands of animals principally upon the by-products of the beet industry; the increase of freight and passenger traffic in the

beet districts; the employment of much labor and the very noticeable development of the country and towns where beets are grown.

By-Products—The by-products of beets bring a good return. The tops and pulp are fed to animals. The tops are left on the ground in the field and pastured by cattle and sheep or hauled and piled for feeding, or siloed for winter feeding.

Pulp is stored in very large silos from which it is hauled to big feed lots and fed principally to sheep and cattle. Molasses may or may not be fed with the pulp. Some pulp is dried, sacked in 100-pound bags and shipped for stock feed. Alfalfa and beet pulp mixed with cotton meal or grain or both constitute the main feeds in the North Platte Valley.

Recovery of Potash—The latest by-product to be recovered in the beet sugar industry is potash. Last year a large concrete reservoir was built at the Scottsbluff plant to collect waste waters from the Steffen-house. The water containing about six-tenths of one per cent of potassium oxide is run into the reservoir for storage until the sugar campaign is over and then returned to the sugar factory where it is carbonated and evaporated to a point where the brine reaches a density in which crystals begin to form. The strong brine is then dried in rotary kilns forming a product which runs 42 to 49 per cent potassium oxide. In 1918, 1,480 tons of potash containing 47.7 per cent potassium oxide were produced at Scottsbluff.

Freight Requirements—The beet sugar industry furnishes a large amount of freight. Railroads haul beets from the dumps to the factories and carry the sugar to market. They also carry a heavy tonnage of coal, coke, and lime rock used in the manufacturing process. During one campaign at the Scottsbluff and Gering factories when 74,204,500 pounds of sugar were manufactured, the plant consumed 40,366 tons of coal, 1,890 tons of coke, 20,295 tons of lime rock, and four cars of sulphur.

Rapid Development—The beet districts of Nebraska are located, where a few years ago, the land was covered with prairie. They were brought under cultivation chiefly through irrigation. The crops first grown were wheat, oats, alfalfa, and potatoes, then beets. The agriculture was extended and intensified and the country is now well developed as to farms, homes, telephones, roads, and schools. The leading towns in the beet districts are Culbertson, McCook, Grand Island, Chappell, Kimball, Minatare, Bridgeport, Bayard, Gering, Morrill, Mitchell and Scottsbluff.

Though a large acreage is cultivated to beets in Nebraska and four sugar factories are operated, it would be possible, because of additional available beet land, to extend the area and support several more factories. The fifth factory is being built at Mitchell and two others may be started soon at other places.

THE POTATO INDUSTRY

By R. F. HOWARD,
Horticulturist, The University of Nebraska

Nebraska ranks about tenth among the large potato producing states. Over 140,000 acres of potatoes were grown in the state in 1917, representing a total yield of over 12,000,000 bushels. A large proportion of the yield is from western counties, including Scotts Bluff, Box Butte, Sheridan, Dawes, Kimball, Banner, Sioux, and Brown. Approximately 2,000,000 bushels are grown with irrigation in Scotts Bluff, Morrill, Sioux, and Kimball counties. Potatoes are raised on most farms and ranches of the state.

Conditions Favorable—On account of the climate and soil conditions in these counties it may be said that the potato will probably continue to be one of the principal agricultural crops. The high altitude insures a relatively low mean temperature. The season is short. The soils are light but fertile. These conditions are all favorable for the production of potatoes. Despite the fact that moisture is the limiting factor for production in certain years, the average yield per acre under dry land conditions is approximately 100 bushels. It is not uncommon to get 150 bushels without irrigation. The average yield where irrigation water is available varies from 200 to 400 bushels per acre.

There are almost unlimited possibilities for extending the potato industry in western Nebraska. Over half of the land suitable for potato production is still in native sod. A three or four-year crop rotation with potatoes as one of the crops makes it possible to grow potatoes indefinitely. It has been demonstrated that the potato soils of this region will grow this crop indefinitely without addition of artificial fertilizers provided a proper rotation of crops is used.

Growing Seed Potatoes—The production of high quality seed potatoes in western Nebraska is a possibility as yet only partially realized. An effort should be made to supply the southern states with seed from this region. Potatoes grown in the central and southern states under ordinary methods of cultivation should not be used as seed the following year. It is generally known that potatoes produced in a cool climate will give a heavier yield when used as seed than potatoes produced under warmer conditions. A comparison of the yielding qualities has been made the past two years of seed produced under dry land conditions of western Nebraska with seed from various other states, including Maine, Wisconsin, and Minnesota. These tests indicate that Nebraska seed will yield as well or better than seed produced in the other northern states.

Kansas, Oklahoma, Texas, Arkansas, and Louisiana need each year approximately 2,000,000 bushels of seed potatoes. To supply even one-

half this demand — at present we furnish less than 10 per cent — would give us a market for over a thousand carloads. This can only be done by first, growing the varieties they need, second, by providing warehouses along the railroads to facilitate mid-winter shipments and third, by sending to these states an inspected high grade product put up in even-weight sacks. The Agricultural College of The University of Nebraska inspects potatoes that are being grown for seed purposes.

The demand for table stock in the states to the east and south of us is several times greater than the demand for seed stock. To supply the proportion of this demand that our proximity to these states justifies would mean increasing our present total yield several times. We should make every effort to win and supply this trade. This can only be done by properly understanding the demands of the south and then by meeting these demands through organized effort.

The Nebraska Potato Improvement Association promotes the potato industry in Nebraska along the lines of production, transportation, and utilization of potatoes. Through it we may expect to see the best varieties and strains of seed potatoes grown and disseminated. It will aid in establishing and maintaining the proper cultural practices and crop rotations in relation to soil fertility and yield.

HORTICULTURAL RESOURCES

By R. F. HOWARD,
Horticulturist, The University of Nebraska

It was demonstrated early in the history of the state that Nebraska could grow fruit of many kinds. There are over two million apple trees now in the orchards of the state, and cherries, plums, grapes, pears, and strawberries are grown in abundance. The greater part of the commercial plantings are in the eastern half of the state; several commercial orchards and hundreds of home orchards, however, may be found in many places in Western Nebraska, especially along the Platte and other valleys.

The deep loess soil formation in the eastern part of the state is especially well adapted to the production of fruit. This soil possesses the elements of fertility to a great depth. It also has a structure that permits the roots of the trees to penetrate it to a depth, making it an ideal soil on which to grow trees of many kinds, especially fruit trees, and vineyards. Large commercial plantings are now being developed there. The natural advantages for growing fruit of superior quality in this region together with the moderate price of the land, make it probable that this will develop into one of the most important fruit growing sections in the middle west.

One of the chief advantages in growing fruit in this section is to be

found in the fact that there will always be a market within a radius of a few hundred miles.

Nurseries—There are over forty nurseries in the state, growing fruit trees, shade trees, ornamentals and other plants. Several of these nurseries are doing a large volume of business, shipping their goods to many other states.

Vegetables of many kinds are grown in every county of the state. The home garden is an important part of practically every farm producing not only fresh vegetables for the growing season but sufficient for canned, dried and stored vegetables for the entire year as well.

The city home gardens constitute in the aggregate an important part in the total garden production of the state. The Junior Division of the Extension Service of the University has forty-one towns doing organized garden work. There are 2,468 boys and girls enrolled.

Commercial Trucking is highly developed in several parts of the state, especially in the vicinities of Omaha, Lincoln, Beatrice, Hastings, Nebraska City, Grand Island, Fremont and South Sioux City.

DRY FARMING

By C. S. HAWK,
Member, State Board of Agriculture

The western part of the state is known as the sub-humid area because of its comparatively low rainfall. There are several kinds of soil in this part of the state, some of which are suitable for farming, and others which are better suited for grazing.

Failure and Success—The early settlers did not distinguish between the soils, neither did they understand that they had come to a country where the amount of rainfall is a controlling factor in agriculture. Many of them used crops and methods of cultivation which were suited only to humid areas. There were failures for a number of years, except for years with heavy rainfall. Finally, after much practical experience and experimentation by state and federal departments, it was found that crops could be grown successfully in much of the western part of the state, but that it required technical knowledge regarding the soils and cultural methods. Seeds from sub-humid areas were introduced and large yields of wheat, oats, rye, corn, and potatoes have been produced.

Suitable Soil—The most successful dry land soils are those which are capable of resisting drouth. First, the soil should be deep, fine-textured, and fertile. Second, it should not be underlain near the surface by sand and gravel. Third, it should not be so loose and light as to blow when plowed. The best dry farming soils have a relatively heavy layer in the subsoil at a depth of 2 to 6 feet. This prevents the loss of water by percolation.

Much of western Nebraska outside the irrigated areas is well suited to the so-called dry farming. One of the best areas is on Dalton Table where the land has been successfully cultivated for a number of years. All told, dry farming is an important factor in the agricultural development of Nebraska. Much of the land formerly grazed has come under extensive cultivation by using methods which conserve the soil moisture and by growing drouth resistant crops. With these practices for the last ten or twelve years northwestern Nebraska has continued to produce good yields of the hardy varieties of small grain, corn, and potatoes.

IRRIGATION IN NEBRASKA

By G. E. JOHNSON,
State Engineer

Irrigation is practiced quite generally and successfully in the western part of Nebraska, where the rainfall is lowest. Much of the irrigation is from canals, but part is from wells. About 450,000 acres are covered by irrigation systems and much of this is irrigated from canals. Much of this is in the North Platte Valley, yet there are successful irrigation enterprises in the Lodgepole, South Platte, Republican, Frenchman, Pumpkin Creek, Niobrara, Hat Creek, White River, and other valleys. The total mileage of canals built in the state is about 2,400 at a cost of more than $11,000,000.

The North Platte is the largest project. Its storage reservoir, known as the Pathfinder, is located 43 miles southwest of Casper, Wyoming. This reservoir holds more than one million acre feet of flood water which when released, flows about 150 miles on the bed of the Platte to the Whalen Diversion Dam where it is diverted to each side of the valley and finally carried to the land to be irrigated. The North Side Canal carries flood water to Lake Alice and Lake Minatare reservoirs of Scotts Bluff County. The north and south side government projects combined have an irrigable area of 252,000 acres, of which about 150,000 acres are irrigated this year. The Inter-State or North Side Project covers 129,270 acres of bench land between Whalen, Wyoming, and the divide between Red Willow and Indian creeks in Nebraska. The south side or Fort Laramie part of the project will cover about 48,000 acres in Nebraska when completed. The Inter-State Canal has a capacity of 1,400 second feet at the headgate. This is reduced several miles eastward to 1,200 second feet and finally to 800 second feet. Lake Alice has a capacity of 14,000 acre feet and Lake Minatare of 67,000 acre feet. Water from these large reservoirs and the river is carried through canals and laterals to the fields and crops.

There are other large Platte River projects in Nebraska. Some of the larger ones are the Tri-State, Gering, Central, Chimney Rock, Bel-

mont, Brown's Creek, and the Beerline Canal, which receive water from the government under contract and from the normal flow of the river. These just named have a combined capacity of considerably more than 100,000 acres. There are quite large projects in other valleys.

The irrigation waters of Nebraska have been carefully surveyed by state and federal departments. They are under the administration of the State Board of Irrigation, Highways and Drainage. Plans are under way to construct additional reservoirs to hold flood waters and to increase the efficiency of water used in irrigation.

Irrigation Farming—The irrigation districts produce vast quantities of alfalfa, oats, wheat, potatoes, beets, corn, vegetables, and fruit. The country is nearly all successfully farmed and well improved. It brings good returns to the land owner and to the renter. Land values range between $100 and $500 or more per acre.

THE BEEF-CATTLE INDUSTRY

By HOWARD GRAMLICH,
Professor of Animal Husbandry, The University of Nebraska.

Nebraska has high rank in every branch of the beef industry, whether it be cattle raising, breeding, feeding, or slaughtering. The industry is supported by extensive grazing areas, fattening feeds, favorable climate, and good water supplies coming from springs, streams, and thousands of wells. Not much shelter is used except windbreaks. The usual absence of winter rains insures comparatively dry under-footing. The industry has grown to a point where the state has 2,374,762 beef cattle (1918).

Cattle Ranches—Much of west-central and western Nebraska is a native prairie which supports successful grazing. The best developed cattle ranches are in the Sandhill Region, yet there are many in the dry farming areas to the west. As a whole, these ranches are large and well managed, some of them having thousands of acres and most of them fenced, and containing both pasture and hay land. In many places the pastures are divided between summer and winter ranges. Small tracts of land are given over to grains, potatoes, and vegetables for ranch use.

Nearly all the ranches have well-bred cattle, prevailing breeds being the Herefords and Shorthorns. Pure bred sires have been used for many generations and most animals are now of good quality.

Ranch Products—The main product of the cattle country is steers. These are mainly shipped as two and three-year-olds. The calf crop is usually dropped in the early spring. The cows and calves remain together until weaning time. No feed other than grass is required

during summer. The calves are branded in the summer and weaned and dehorned in the fall. They are kept in corrals adjacent to the ranch buildings during the winter and are sometimes fed a small amount of cottonseed cake and alfalfa in addition to the native hay. All animals graze upon the winter range which is land that has not been pastured the preceding summer. The hay is fed during storms and when the ground is covered with snow.

After the first winter the calves are permitted to rustle for themselves, receiving no additional feed, except hay, until they are marketed at the age of about 3 years. Two-year-olds weigh 800 to 900 pounds and three-year-olds 1,100 to 1,200. The heavy steers are sold direct to the packers for beef purposes and the lighter ones are sold as feeders.

The cows and bulls are shipped to market after a few years of use for breeding purposes. Though most of the cattle of the ranch country are raised in Nebraska, many animals are shipped in from other states and finished on the ranches and in the feed lots of the state.

Cattle Raising on Farms—The eastern and southeastern parts of Nebraska are devoted principally to farming. Cattle raised on these farms are sold either as feeders or finished for market. In many places animals serve for both beef production and dairy purposes. There is not so much specialization in beef production here as in the ranch country. The dual purpose type of cattle is also found in the dry farming and irrigated areas of the western parts of the state.

Feeding for Market—The agricultural sections of the state produce an abundance of finishing feeds, such as corn, alfalfa, and beet pulp. Many farmers engaged in cattle feeding, finishing their homegrown animals for market. A specialized form of the industry is carried on in large feed yards, such as those at Central City and Scottsbluff, where thousands of animals are handled. Some of the feeder steers come from nearby farms, but most of them are shipped in from the range country. Feeding begins in late fall and is finished in the late winter or spring months. The animals are brought gradually to a full feed, at first their feed being derived from stalk fields, the aftermath of hay meadows, damaged hay and other roughage which represents virtually no commercial value. Then the steers are fed about 25 pounds of alfalfa per day until grain is added. Within about a month after corn is added the steer is fed 10 pounds of corn per day; another 30 days and he is usually on a full feed of about 20 to 23 pounds of corn and 8 to 10 pounds of alfalfa per day. In 90 days the steer is ready for market in the form of so-called near-beef and usually passed as a short-fed steer. Where there is ample grain, animals are fed 60 days longer, producing steers grading as prime on the market.

The old practice of feeding steers from 6 to 8 months has almost disappeared since alfalfa became available. Most steers are now marketed by the time they have consumed 20 bushels of corn, whereas in

former years when prairie hay was used, it required 50 to 60 bushels of corn to finish an animal for market.

The Silo—The silo has played an important part in the beef industry of Nebraska. It conserves the corn plant ear and all in the form of ensilage which is a palatable nutritious feed at a relatively low cost. Ensilage is used in many feed lots from 30 to 60 days before corn is added to the ration. Steers are finished on corn and alfalfa, the latter being kept before the animals at all times. The advantage of ensilage is that it contains considerable water and tends to take the place of the grass provided by nature during the summer. From the standpoint of economy the silo is well worth while since the corn plant when allowed to remain in the field during the fall and winter deteriorates very rapidly and the animals derive very little feed therefrom. When cut in the fall and stored in the silo the plant makes good feed at all times.

Gain From Feeding—Careful records have been kept in many instances and it has been found that a steer consumes from 7 to 8 pounds of corn and from 5 to 6 pounds of hay in producing one pound of beef. Hogs following the steers utilize sufficent nutrients from the waste involved in the production of one pound of beef to make one-sixth pound of pork.

Baby Beef—Some eastern Nebraska farms have sufficient pasture to warrant the farmer in keeping a small herd of cows to raise calves. Usually, there is not enough pasture on these farms to carry the steers into the yearling and two-year-old forms, consequently the calves are fattened as baby beef. By this method, the calves are taken at weaning time in the fall and started immediately upon a heavy grain feed. The calves fatten more slowly than older steers, consequently it is necessary to feed for a longer period. As a rule, baby beeves are placed in a feed lot in October, marketed the following May or June, weighing 800 to 900 pounds and commanding a price fully as high as the choicest cattle. The demand of the public during the recent years has been for small cuts of beef which have been secured only by marketing younger animals, consequently baby beef is very popular and eastern Nebraska has found its production to be remunerative. Though the calves are fed heavily on grain and do not consume a great quantity of roughage, cows are carried through the winter on roughage which would otherwise be fed to steers, were they being fattened.

Cattle Breeding—Nebraska is an important cattle-breeding state. Most of the breeders are in the eastern and southern parts of the state. The Mousel Brothers of Cambridge carry a breeding herd of 500 registered Herefords. Registered animals of these and other breeders are sold at advertised sales and used locally or shipped throughout the state, or to other states. Many breeding animals are imported.

Cattle Markets—Some of the best animals of the ranches are shipped directly to market. Others are finished in feed lots and marketed in Omaha and other places for slaughter. The Omaha market is one of the largest in the United States, with its big slaughter houses and packing plants. The records show that the Omaha market received 1,993,366 head of cattle during 1918, of which 1,150,635 were from Nebraska. In 1919 this market received 1,975,236 cattle of which 1,066,204 were from Nebraska. During the last thirty-five years 30,481,187 head of cattle have been shipped to the Omaha market.

THE DAIRY INDUSTRY

By J. H. FRANSDEN,
Professor of Dairy Husbandry, The University of Nebraska.

Nebraska has importance in dairying, yet the conditions favor a much larger development of the industry. Among the favorable conditions are healthful climate, good water, a large number of suitable feeds, and transportation facilities for marketing the dairy products.

Number of Cows—The number of milk cows reported for Nebraska has increased during the past few years. The 1918 census shows 530,113 cows valued at $47,710,170. This is a distribution of about seven cows per square mile, whereas there is room for three or four times this number.

Forms of the Dairy Industry—The dairy industry includes the production of milk and cream, butter-making and the by-products connected therewith, and the manufacture of large quantities of ice cream. Creameries, cream stations, condensories, and milk depots are established in various parts of the state. The largest butter-making centers are Omaha and Lincoln.

Milk is produced and separated on many farms and ranches. The separated milk is fed to live stock and the cream is used or shipped. Many small dairies supply the towns and cities with milk. Some home-made butter is sold on local markets. Small and large dairies haul and ship milk to towns and cities. Cream is collected at hundreds of stations and shipped to the butter-making centers.

Feeds—Concerning the feeds for dairy stock it should be noted that corn grows abundantly throughout the eastern counties and in smaller quantities in other parts of the state. Sufficient corn is grown in central and western counties to furnish some grain and roughage either as fodder or in the form of silage. Alfalfa grows throughout the state with heavy yields in the irrigated districts and in the central and eastern counties. Sorghum, millet, sweet clover, and kafir are raised in the western counties where the rainfall is least. Abundance of grass

and prairie hay are produced in the grazing areas. The grazing season is long, thus favoring dairying.

The production of much roughage makes Nebraska a desirable dairy state. The roughage is bulky, making its shipment expensive, thereby decreasing the profits. It is a significant fact, however, that eastern farmers buy expensive products of this kind for dairy cows and realize a good return upon the investment. The prices paid for dairy products in the east are not much better than those received by Nebraska farmers and our farmers are beginning to feed more grain and surplus roughage to dairy cows, enabling them to save the time and expense of hauling the bulky products and to make a good profit on the production from the cows.

Cows Conserve—The dairy cow is efficient in converting the nutrients of plant roughage into human food. In one year a good dairy cow will produce as much food matter in her milk as is found in the carcasses of five steers, averaging 1,100 pounds. It is obvious that she will not eat as much in one year as the steers. In fact, she will eat little more than one of these steers in his last year of feeding. When the steer is butchered his work is done, but the cow stands ready to repeat her performance every year. Of all live stock, the dairy cow has greatest economic value in conserving for human consumption the food nutrients produced from the soils (Figure 18).

Nor are the soils injured by dairy farming. The farmers over the state are beginning to realize the need of soil conservation. This is due to the bad effects of constant grain farming. Grain crops shipped from the land deplete the fertility, whereas the dairy cow returns the fertility to the soil. This means that agricultural prosperity demands that more of the grain, roughage and hay should be fed on the farms and not shipped. This is in line with the system of dairy farming carried out in Denmark, where soils have been built up to a high degree of productivity by the use of feeds derived principally from America.

In portions of Nebraska live stock is the one sure crop. For men with small farms and limited capital and especially for those who have a surplus of labor, dairying is undoubtedly the safest form of live stock farming. The monthly cream check tides over many farmers, especially during times of drouth. The more extensive dairying in the vicinity of the larger cities brings good returns to those engaged in the business.

Dairy Breeds—Among the leading breeds of Nebraska are the Holsteins, Jersey, Ayrshires and Guernsey. Dual purpose breeds are on many farms and ranches. Attention is given to the breeding and improvement of dairy cattle in the state. This is promoted by many independent breeders and by the dairy department and experiment stations of The University of Nebraska. The state has produced a number

of champion cows. One of these, owned by H. C. Young of Lancaster County, has a record surpassing all previous records of Jerseys in Nebraska and excelling the best Holstein record. For the year ending October 15, 1918, this cow, Mermaid's Fancy Wax, produced 15,542.9 pounds of milk, containing 844.56 pounds of fat, the average test being 5.54 per cent.

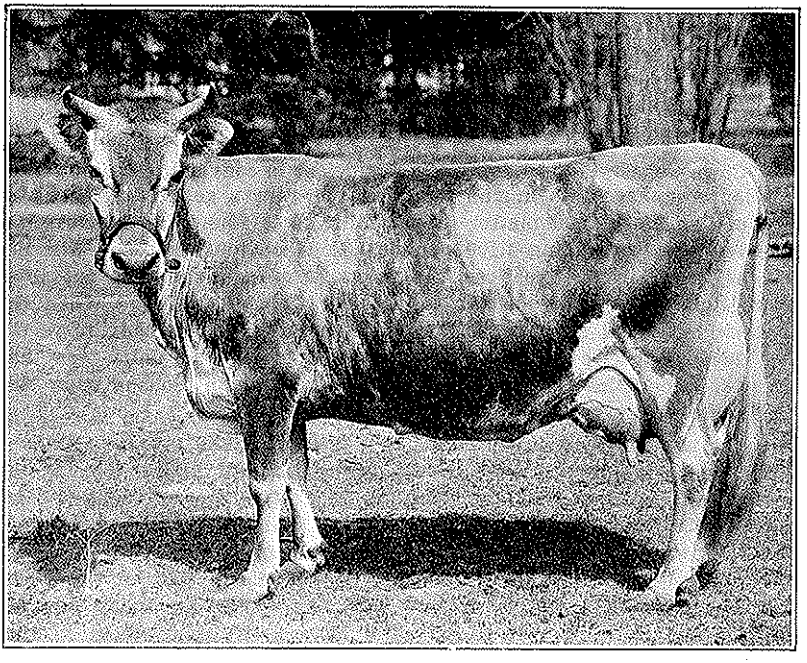


Figure 18. Mermaid's Fancy Wax, the Champion Cow of Nebraska in 1919. This cow, owned by H. C. Young, of Lincoln, produced 15,225 pounds of milk, containing 1,056 pounds of butter, between October 24, 1917, and October 24, 1918.

Production of Butter—Nebraska is rapidly advancing in butter production. There is production on nearly all the farms and ranches but the commercial output is chiefly from large creameries in cities. There are a number of small creameries in towns, but much of the cream finding its way into butter reaches Omaha, Lincoln, Fremont, Hastings, Grand Island, and Fairbury. There is more butter manufactured in Omaha than in any other city in the world. In 1915 the creameries of the state manufactured 42,076,300 pounds of butter.

Cream-Milk—The principal markets for sweet cream, sour cream, and market milk are Omaha and Lincoln, together with many rapidly

growing cities in various parts of the state. The demand for good market milk is strong. Transportation is well provided by a network of railroads. In 1915 Nebraska farmers produced and sold 10,444,920 gallons of cream and 1,271,634 gallons of market milk.

THE SWINE INDUSTRY

By SAM McKELVIE,
Clay Center, Nebraska.

Corn and hogs are closely related in production and partly owing to this fact Nebraska is now the second greatest swine producing state in proportion to its population, being second to Iowa. Though corn has always played a very large part in feeding, a second factor, alfalfa, holds an important place in the hog industry of Nebraska.

The report of the State Board of Agriculture shows that there were 1,680,460 hogs in the state in 1910. By 1918 this number had jumped to 2,038,460. The total value of hogs in 1910 was $18,084,400, while in 1918 it was $61,147,080.

From my personal experience, dating back to the 70's, I regard swine production in Nebraska one of the most profitable, if not the most profitable, of our livestock pursuits.

Breeds—The main breeds of hogs raised in Nebraska are the Duroc Jersey, Poland China, Chester White and Hampshire. Although the hog business is primarily a market venture, there is a great deal of pure-bred stock, and practically every community has its breeders. Hogs might be called a universal crop in Nebraska, since practically every county raises its share. Most animals are found in the areas growing most alfalfa and corn.

Feeds—Nebraska farms produce an abundance of feed best adapted to fattening hogs without resorting to commercial feeds, unless the farmer so desires. The soil of the state seems to be the natural home of the alfalfa plant, which takes the place of the by-products of grist mills which were formerly purchased to form a balanced ration with corn. In most sections of Nebraska are to be found fields of alfalfa stretching in every direction, and in some counties, as Scotts Bluff, Dawson and others similarly located in the western and mid-western parts of the state, alfalfa is the big crop. Where mill feeds and ordinary commercial stuffs are fed, rapidly advancing prices have to a large extent eliminated profits, but where there is a good breed of hogs and careful management, and where alfalfa is used to the best advantage, there is a profit in the business, which with a gradual return to normal conditions will show rapidly increasing returns.

Alfalfa is not only of value in the hog business as pasture, but the hay makes good winter feed. I have found that where feeding ground

feeds one can grind alfalfa and mix it with ground grains and it will take the place of the present-day shorts at a materially less cost. To a large extent the hog business furnishes a profitable means of taking care of the immense quantities of corn and alfalfa produced in the state.

Quick Returns—While both cattle and hogs conserve the fertility of the soil, one gets quicker returns from the hog than from the steer. One calf is produced by each cow annually and usually has to be kept until about two years old before marketing, while a sow will produce a litter in the spring that with careful treatment can be marketed before the snow flies, and even a second litter within the same year. I would say frankly that I would not think of trying to operate a Nebraska farm profitably without growing hogs thereon.

Market—Omaha, with railroad lines radiating out into every section of the state furnishes a fine market for hogs. The Omaha yards received 3,429,533 hogs in 1918 and received 67,500,753 during the 35-year-period from 1884 to 1918 inclusive. In 1919 these yards received 3,179,116 hogs of which number 2,274,936 were from Nebraska. Another development is the motor truck method of hauling hogs to markets which in eastern Nebraska is becoming more common. Some Nebraska hogs are shipped to Denver, St. Joseph, Kansas City, and Sioux City.

THE SHEEP INDUSTRY

By J. D. WHITMORE,
President of the Valley Stock Yards Company.

Sheep raising is increasing in Nebraska. Many farmers and ranchmen carry a few animals to clean up roughage. Sheep raising has great importance in the states to the west and northwest of Nebraska, from which many animals are shipped into this state for feeding, and to market. Much of the breeding-stock of the sheep-growing states is produced in Nebraska.

The Agricultural Reports show that there were 278,821 sheep on farms and ranches and 108,000 sheep were owned for breeding purposes in 1918. Larger numbers than these were fed in the state. It is not possible from data at hand to give the total sheep population of Nebraska.

Breeding—There are a few places in the state where breeding sheep are raised commercially. Mr. Robert Taylor of Abbott (near Grand Island) the largest operator, is among the pioneers. He sells hundreds of lambs and sheep of both sex to western range sheepmen annually. Several others operate in the same manner in different localities, but on a smaller scale.

Sheep Feeding—This is of two kinds—the feeding or fattening for market and feeding-in-transit. The sheep grown in the northwestern states must be fed on the way to market and many of them are finished for market on Nebraska's prairie hay, and other feeds. Our feeds are between the grazing country and the big markets. This gives to the state a great advantage in the sheep industry. Much feeding is done on a commercial basis, yet there is a noticeable tendency for the land owners to engage in the sheep-feeding business. This enables farmers to market farm products on their land, thus obtaining large quantities of manure and affording winter work. This feeding is principally in the districts of intensified farming, and particularly in the irrigated sections, where much alfalfa is grown.

Largest commercial feeding of sheep is in the vicinity of Scottsbluff, Gering, and Bayard, where many thousands of animals are fed. Two years ago more than 300,000 sheep were fed within a short radius of Scottsbluff. The beet sugar companies and private parties engage in feeding. Some of the largest feed yards of the United States are at Shelton, in an alfalfa and corn belt.

Most sheep fed in Nebraska are from west and northwest on feeding-in-transit billing, and when finished, shipped to market at a small additional cost for freight over the straight point-of-origin to final destination rate.

Transient Feeding—Sheep fattened on the western ranges are shipped direct to market for killers, and many of them pass through Nebraska on the Union Pacific, Burlington, and Northwestern railroads. "The regulations of the United States Department of Agriculture provide that live stock of any kind shall not be confined for a period longer than twenty-eight consecutive hours without unloading same in a humane manner into properly equipped pens for rest, water, and feeding for a period of at least five consecutive hours unless prevented by storm or by other accidental or unavoidable causes which cannot be anticipated or avoided by the exercise of due diligence and foresight, except, however, upon the written request of the owner or persons in custody of any particular shipment, the time of confinement may be extended to thirty-six hours."

To comply with these regulations as well as to care for the best interests of the shippers, the railroads have established feed yards along their lines—the Union Pacific at Sidney, North Platte, Grand Island, Fremont, and Valley; the Burlington at Alliance, Aurora, McCook, Hastings, and Burnham; the Northwestern at Long Pine and Fremont. Millions of sheep and other stock are fed at these feed yards annually on their way to the Chicago and Missouri River markets, as well as to feed lots.

Many successful stockmen find that it does not pay to keep stock off feed too long, and therefore feed oftener than is required by law.

Nearly all of them feed long enough at the last feeding-in-transit point to get back part of the shrink caused by shipment, and put the sheep on the market in a much better condition thereby obtaining better weights and higher prices.

Markets—The big Nebraska market is at Omaha. The yards here received 3,385,696 sheep in 1918 and have received 51,330,802 sheep for the 35-year-period ending with the year 1918. In 1919 3,789,188 sheep were received of which 870,330 were from Nebraska. Part of the wool clipped on the ranches and at the feed yards goes to Omaha warehouses. The chief product of the animals at the packing houses is mutton.

THE HORSE INDUSTRY

By WILLIAM THOMAS BRADSTREET,
President of the Grand Island Horse Market.

While horse raising in Nebraska is not a leading industry, there are numerous breeders of purebred stock and a large number of farmers who make a practice of raising a few horses as a sideline. The auto, truck, and tractor have reduced the demand for horses in most places, yet few farms in the state have been able, with motor power, to do away with horses altogether.

Those who find the horse business a profitable one generally make a practice of keeping a few mares on the place for general work and in addition raise a few colts per year. There usually is a good market for horses and any surplus can be disposed of to neighbors or at sales with little trouble. Just now few horse colts are raised. The mule is preferred and mule colts are increasing at the expense of the horse.

Number of Horses—The report of the State Board of Agriculture showed 910,079 horses and 102,192 mules in the state in 1918. There were 924,756 horses in 1912, showing that the decrease from the maximum number has been comparatively slight. But as compared with 1910 and previous years, there is today an increase in total number of horses. The mule population is increasing. Many horses are shipped in from western states for use on Nebraska farms. More horses are shipped out, however, than are shipped into the state.

Horses on Ranches—The large cattle ranches of the central and western counties require a good many horses for riding and hay-making. Formerly they were used for driving, but the auto has displaced the horse at most places for this purpose. Evidently, the ranches will continue to need horses.

Horses on Farms—Though motor power has come into general use in Nebraska and much of the plowing, harvesting, and hauling is done with machinery pulled or driven by this power, there remain a number

of places where horses are the more dependable. We believe, on this account, that it will be many years before horses disappear from Nebraska farms because they are better suited than tractors and trucks on many farms located on many kinds of soils.

Race Horses—The state has produced a number of animals that have made good records, particularly in trotting and pacing. It seems, however, that the number of race horses raised in Nebraska is decreasing.

Horse Markets—There are a number of local sales places in the state and two large general horse markets. These markets are at Grand Island and Omaha.

Horses reach these markets from Nebraska and several other states. They are brought in generally from the northwest, from as far as California, and shipped to the eastern and southern states as well as to closer points. At times more than twenty states are represented by buyers at these sales which are held twice a week in the winter time and less frequently in the summer time.

The barns at South Omaha and Grand Island are well equipped for handling horses. The animals are received and shaped up for sale. They are classed as broke and unbroke animals. Those sold as "broke" are tested for wind and work and are sorted and graded as to age, size, and soundness. The animals are sold in the stall or from the pen, but more generally from the ring on auction day. The principal grades are pony, southern, farm chunk, draft, and heavy draft. There are few calls for fancy saddle horses, and the roadster is nearly a thing of the past.

Horse Feeding—Many farmers feed their horses for sale. Companies and individuals fatten horses particularly in the vicinity of the big markets. The animals are fed like cattle. The draft and heavy draft animals are the ones usually handled. The feeding period is 30 to 90 days, averaging about 60 days with a gain of about 3 pounds per day. Corn, oats, alfalfa and bran are used.

THE POULTRY INDUSTRY

By F. E. MUSSEHL,
Professor of Poultry Husbandry, The University of Nebraska.

Poultry raising is an important branch of agriculture in Nebraska. It includes chickens, ducks, geese, turkeys and guinea fowls. These contribute annually more than $50,000,000.00 to the state's wealth, principally from poultry and eggs. Chickens lead in the value of production. Several varieties are grown, such as the Rocks, Wyandottes, Reds, Cochins, Brahmas, and Leghorns. There is considerable specialization to meet the market conditions, and poultry breeding is carried on generally throughout the state.

Poultry Population—The poultry population of Nebraska is about twelve million birds. Hamilton County leads with one-third million birds. There are about twenty-one thousand incubators and brooders in the state, and it is estimated that 170,000 people raise chickens on farms and ranches or in the back yards of towns and cities. Much of the poultry and many of the eggs are used by the producers or sold on local markets but large quantities become commercial.

Conditions Favorable—Nebraska is very well adapted to poultry raising because of its favorable climate as shown by the subhumid atmosphere, long periods of sunshine, and because of the abundance of feed and a ready market. There is comparatively little trouble with poultry diseases and destructive animals. Chickens and one or more forms of other poultry are grown on practically all ranches and farms of the state. The industry is specialized at various points for raising breeding stock and exhibition stock .

Poultry Associations and Exhibits—There are a number of poultry associations in the state, and the poultry department of The University of Nebraska is furthering the industry, both as to instruction in the Agricultural College and as a part of the extensive work done throughout the state. Poultry exhibits are made at all county fairs and a large and complete exhibit is made each year at the State Fair.

Poultry Feeding—Poultry is a large item in the meat supply of most homes in the state. Farmers sell grown birds to town folk and to large milk feeding plants located in about 20 towns and cities. The birds in the feeding plants, as at Omaha, Lincoln, Hastings, Falls City, Crete, and Grand Island are finished within about two weeks on mashed feed. The gain is rapid; the birds now in good condition are killed and packed for shipment to the eastern cities or to foreign countries. Many of these large birds go for roasts.

Baby Chicks—The production of baby chicks in hatcheries especially developed for this purpose has become an industry in itself. The manu-

facture of incubators, brooders, trap nests, and similar appliances has importance. These efficient labor-saving devices aid in conserving the poultry industry which is rapidly extending in importance and as an adjunct to the general agricultural development.

BEES IN NEBRASKA

By FRANK G. ODELL

(Mr. Odell, formerly an expert bee keeper of Nebraska, has a national reputation as an authority on this subject.)

Bee keeping has been well established in Nebraska since pioneer days. In recent years specialization of this industry has grown considerably in the state with good results. Numerous beekeepers near the cities maintain profitable apiaries. In the Platte Valley, particularly in the alfalfa growing districts in the western part of the state, bees are very profitable and the honey yield is uniformly satisfactory. The state reports show 25,107 stands of bees in Nebraska in 1919.

The principal plants which produce a marketable quality of honey, in the order of their importance are: alfalfa, white and alsike clover, sweet clover, and heartsease, the latter plant yielding the principal autumn crop.

Alfalfa produces a honey of good flavor, water white and with a marked tendency to granulate, or turn to a sugary consistency. This granulation is quickly overcome by heating the honey in a water bath which soon restores it to the liquid state.

White clover and sweet clover produce honey of superior flavor and light amber color. Sweet clover is abundant in waste places and yields a heavy crop of honey.

The commercial beekeeper now gives preference to the production of extracted honey because of the relatively larger yield and the smaller expense of production.

It is estimated by good authority that the average section of pasture or waste land in Nebraska will yield an annual crop of at least 1,000 pounds of extracted honey if bees are sufficiently near and have proper care.

The value of honey bees as active agents in pollination of fruits, vegetables and pasture grasses has long been recognized. From this standpoint alone, every farm should maintain a few colonies of bees. Preference is given by experienced bee keepers to Italian bees as they are more gentle and better workers.

MANUFACTURERS OF NEBRASKA

By FRANK I. RINGER,
Commissioner, Nebraska Manufacturers' Association.

Every person in Nebraska knows that this state is one of the leading agricultural states of the union, that in wealth per capita she is one of the first and that her public school system is second to none. Yet how little is known of the manufacturers.

How many people know that the annual output of the state's factories is valued at more than a half billion? Or that shoe strings, suspenders, and spark plugs are made in Omaha, index tags at Exeter, refrigerators minus corners at Fremont, dandelion rakes at Kearney, butter tubs at Ralston, rubber collars at Lincoln and chewing gum at Fairbury?

But these are only a few of the more unusual industries. Besides these we have some 4,000 factories engaged in a wide variety of industries and utilizing a large proportion of the raw materials produced within the state.

The four sugar factories located at Grand Island, Scottsbluff, Gering, and Bayard will this year convert the beets from more than 50,000 acres of Nebraska's finest land into 1,700,000 sacks of sugar, valued at $20,000,000.

One of the valuable by-products from these factories, is the potash which is obtained by evaporating the water used in washing the beets during the sugar season. Thousands of cattle and sheep are fattened annually on the by-products—beet tops, pulp, and molasses.

We boast of Omaha as being the largest dairy product market in the world and Lincoln claims one of the world's largest creameries, owned and operated by Nebraskans, The Beatrice Creamery Company. In these huge plants and the smaller plants scattered over the state, the cream and milk from Nebraska's dairy herds is made into butter, cheese, and condensed milk, the value of which is greater than the combined wool and mutton output of any state in the union.

A large part of our enormous wheat crop never leaves the state except in the form of flour, breakfast foods, crackers, macaroni, etc. Practically every town has its own flour mill, ranging in size from the small one-man mill to some of the largest and most up-to-date plants west of the Mississippi River. From these mills, besides supplying the home demand, flour is shipped to all parts of the world.

Large quantities of wheat are also used to supply the demand of such firms as the Loose-Wiles Biscuit Company, the Iten Biscuit Company, the Skinner Manufacturing Company, and the Uncle Sam Breakfast Food Company of Omaha, the Gooch Milling Company of Lincoln, and the multitude of smaller concerns over the state. The Iten Biscuit Company operates the largest exclusive cracker factory west of Chicago

their daily output of crackers exceeding six car loads. The Skinner Manufacturing Company has long since proven that Nebraska and not Italy is the home of macaroni and is now known as the largest macaroni factory in the world, and the product of the Uncle Sam Breakfast Food Company is known across the seas.

Another important branch of the industry is alfalfa milling. There are a number of plants scattered throughout the state of which M. C. Peters Mills Company of Omaha is perhaps the largest. These mills annually produce thousands of tons of alfalfa meal, valued at over $5,000,000, which is distributed over Nebraska and neighboring states.

As a live stock market Omaha ranks second, and as a meat market and packing center, third in the world. Seven large packing companies and a number of smaller concerns maintain plants in this city with an output during the year 1918 valued at $288,820,787.00.

Candy factories, canning factories, dehydrating plants and soda water factories are thriving industries and consume enormous quantities of Nebraska grown fruits, vegetables, and sugar.

Ready-to-wear clothing is made in a dozen factories and Nebraska-made boots, shoes, and hats are known in practically every state.

Farm implements, pumps, mills, and harness are made in quantities and a ready market is found not only in Nebraska and the other states, but in Canada and South America as well. At least three manufacturers of gas engines, trucks, auto bodies, and repairs enjoy a profitable foreign trade.

Although few in number, the brass and iron foundries and sheet metal works of the state, collectively do an extensive business and ship their products over a wide area. The railroads are, perhaps, the largest consumers.

The war seriously affected producers of building material but the present building activity finds them running full blast once more and in difficulties supplying the local demand, for brick, tile, cement and structural steel. Some of the finest and largest deposits of sand and clay in the west are found in Nebraska and her people are well acquainted with the sand dredges and the brick and tile factories.

It is not long since all engraving, lithographing, binding and printing was sent out of the state. There is no further occasion to do so now for Nebraska plants are equipped with the most modern machinery and the latest methods of production. Steel plate engraving, lithographing and book binding and publishing are now important industries.

Several well known incubators are made in the state as at Clay Center, Lincoln, Wayne, Fremont, and Omaha, and distributed from Cape Town to Hong Kong.

Stock feeds and hog cholera serums are made in Lincoln, Ralston, Red Cloud and a half-dozen other places.

Boxes and bags for the shipping of Nebraska products are made at

home and our Nebraska soldiers were sheltered by tents from their own state.

Although the activities of our many potash factories were somewhat deranged with the end of the war, they are rapidly returning to normal and will soon, as before the war, be producing sixty per cent of the potash output of the states. There are eighteen small potash plants and nine large plants in Nebraska. There is a large Portland cement plant in successful operation at Superior, Nebraska.

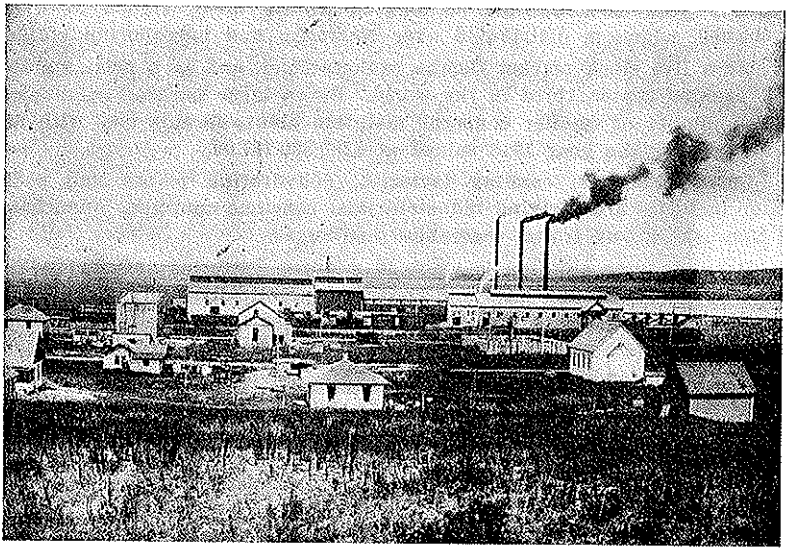


Figure 18a. One of the potash plants at Antioch, Nebr.

Nebraska has one of the largest smelting and refining plants in the United States with an output in 1918 valued at $48,000,000.

Although there is very little broom corn raised in the state, the largest broom manufacturers in the states, the Lee Broom and Duster Company, is located at Lincoln and another huge plant is at Deshler.

The only floor tile manufactured west of Indiana is made in Lincoln.

Nebraska-made cigars find their way into practically every state and Nebraska-made toilet preparations can be found in shops on Fifth Avenue.

Although Nebraska may never equal some of her eastern sisters in the manufactures, she is only beginning. The past ten years has seen a phenomenal growth and with our unlimited production of raw material and excellent transportation facilities the coming years will bring even greater advancement in this line of development.

TRANSPORTATION, COMMUNICATION AND MARKETS

RAILROADS AND INTERURBANS

By H. G. TAYLOR,
State Railway Commissioner.

Mileage and Distribution—Nebraska is comparatively well served with railroads, having 6,742 miles of main line and approximately 500 miles of double track. This is equivalent to a mile of road for every 200 people. Iowa, perhaps as well developed from a railroad standpoint as any middle western state, has about the same per capita mileage. Unlike Iowa, the Nebraska railroads are unequally distributed geographically, due to the greater density of population in the eastern part, 72 per cent of the population being in a territory in the eastern end comprising only 29 per cent of the total square miles. In this 29 per cent territory there are 3,255 miles of road, which is almost 52 per cent of the entire state mileage. In an area comprising 42 per cent of the square miles, there are 4,392 miles, or 66 per cent of the total road, and in an area in the western end of the state comprising 58 per cent of the total square miles there are 1,472 miles of road, or less than 24 per cent. In the 29 per cent territory, the average distance from a railroad station is seven miles. In the remaining 71 per cent of the area, the average distance is fourteen miles.

Railroad Systems—Seven railroad systems operate in the state, namely, Chicago & Northwestern; Union Pacific; Chicago, Burlington & Quincy; Missouri Pacific; Chicago, Rock Island & Pacific; Chicago, St. Paul, Minneapolis & Omaha, and the St. Joseph & Grand Island. The latter road is now a subsidiary of and operated under the Union Pacific management. The C. St. P. M. & O. has a close relationship with the C. & N. W. Other railroads have terminals in Omaha.

Trunk Lines—The state is traversed from east to west by four trunk lines. Two are owned by the C. B. & Q. and the others by the Union Pacific and C. & N. W. Of these, the line operated by the Union Pacific is the only one with a double track for the entire distance. It is also equipped with a complete electric block signal system. The Burlington in recent years has had under construction a second track on its congested line between Omaha and Lincoln. This is completed except for a distance of about seven miles between Waverly and Greenwood.

The Burlington has the largest system in the state, operating approximately 2,900 miles. In addition to its two trunk lines, it has an extensive system of branch lines which tap developed farming sections. The 1,211 miles of the Union Pacific and the 1,102 miles of the Northwestern consist very largely of main lines, although both roads have

several branches reaching well developed territories. Due to the large amount of main line mileage in the state the standard of roadway as a whole is as high or higher than in other states. It has better service, both passenger and freight than is possible in a territory served very largely by branch lines or short roads. The Union Pacific for example, operates daily about twenty-five passenger trains on its main line between Omaha and the western end of Nebraska, all but a few of which carry intra-state passengers. The other three trunk lines crossing the state maintain excellent service also. In connection with the other roads and the various branch lines, these form a system of transportation that knits the state into a compact unit and very effectually serves to co-ordinate all its varied industries.

New Lines—There are territories in the state, notably in the middle western and northwestern part, capable of great development, that are not reached by railroad. Construction of new lines and extension of existing lines has been very limited in the past ten years. The extension of the Union Pacific from O'Fallons up the valley of the North Platte to Gering and later to the Nebraska line is the longest extension constructed in recent years. When the Union Pacific acquired control of the St. J. & G. I. it built a connecting line from Gibbon to Hastings, over which it has diverted a large amount of freight traffic to and from Kansas City and the south. A Burlington cut-off recently built from the Ashland-Sioux City line of the Burlington to the main line at Chalco shortens the distance between Omaha and Sioux City.

Tonnage and Revenue—A hasty survey of statistics filed by the railroads with the State Railway Commission presents graphically the extent of the transportation business in Nebraska, and at the same time offers concrete evidence of the rapid development of the state. For the purpose of comparison, the figures for the years 1908 and 1916 are used. In 1908, the total revenue tons carried aggregated 17,029,344 while in 1916, the tonnage had increased to 26,521,203 tons, or over 55 per cent. The gross revenue from all sources in 1908 was $30,639,859.00 but by 1916 it had doubled, being $62,124,463.00. The total expense in 1908 was $19,333,480.00 and $37,066,418.00 in 1916, this leaving a net income in 1908 of $11,335,844.00, which grew to $25,356,090.00 in 1916.

Livestock and Grain Shipment—In 1908 the railroads forwarded 58,967 cars of livestock in the state. In 1916 they forwarded 78,158 cars, or a gain of about 33 per cent. The shipment of grain and grain products forwarded reflect the same satisfactory increase. In 1908 41,147 cars were shipped while in 1916 the number reached 52,041, or a 26 per cent increase. These figures indicate a greatly increased production of agricultural products in the nine years covered. Comparison of other commodities would disclose the same rapid progress in the development of the state's great resources.

Passenger Traffic—The general prosperity of the state during this period is further reflected by the statistics with reference to passenger traffic. In 1908, 8,622,627 passengers were carried in the state, paying a total revenue of $5,078,999. In 1916, 10,460,663 passengers paid $6,024,075. This represents a gain of 21 per cent in passengers carried and 18 per cent in revenue received.

Rate Situation—The rate situation in the state, as elsewhere in the United States, has been somewhat chaotic since the railroads were taken over by the federal government. The final disposition of the roads, should, however, correct this condition. Prior to 1914, the rate structure rather favored certain specific jobbing points, but in that year the Railway Commission promulgated a schedule of class rates that served to equalize conditions. Subsequently, this was somewhat interfered with by an order of the Interstate Commerce Commission, but on the whole, the situation, as it stood at the time the United States entered the war, permitted a free and unrestricted development of any community so far as freight rates constituted a factor in that development. As industries develop, of course rates must be adjusted to meet their changing needs. The rate structure normally is sufficiently elastic to permit of growth.

From the foregoing facts, it would appear that Nebraska is well favored and that the development of the state's tremendous resources will not be seriously limited in any way by a lack of transportation.

STREET AND INTERURBAN RAILWAYS

There are approximately 220 miles of street and interurban railway in Nebraska, operated by seven companies. Of this mileage, 129 is operated by the Omaha & Council Bluffs Street Railway Company and 58 by the Lincoln Traction Company. The other companies, largely interurban in their character, are as follows: Omaha, Lincoln & Beatrice; Omaha & Southern Interurban Railway; Lincoln, Capital Beach & Milford; Omaha & Lincoln Railway & Light; and the Bethany Traction. The seven systems carried 88,395,179 passengers in 1916, of which 68,432,670 were passengers paying fare, the remaining being non-paying passengers. It is interesting to compare these figures with the showing for 1908. In that year the total number of passengers carried was 51,182,242, of which 50,680,499 paid fare and 501,743 were non-paying. The gross revenue in 1908 amounted to $2,711,238.00. In 1916 it had increased to $3,931,735.00. These figures indicate the growth of the state's two largest cities and their environs. They show that the number of passengers per mile of road has practically doubled.

The development of interurbans has been somewhat slow, but the next few years will probably witness considerable building of that kind. Lines have been surveyed to connect the principal cities in the eastern part of the state, the Omaha, Lincoln & Beatrice being one of these,

which as its name indicates would connect the three towns mentioned. The development of extensive systems of hard-surfaced highways and the impetus that will give to the use of the truck and the automobile may interfere to some extent with a further expansion of electric railways, but in either case the more densely settled sections of the state are fairly certain to be provided with a quick and economical system of transportation for short hauls.

MARKETING AGRICULTURAL PRODUCTS

By H. C. FILLEY,
Professor of Rural Economics, The University of Nebraska.

Nebraska has a ready market for her most important products. Corn, wheat, oats, and barley are purchased by a thousand country elevators and shipped in carload lots to the grain exchanges at Omaha and Kansas City. There are more than four hundred farmer-owned, co-operative elevators in Nebraska.

The success and rapid development of the co-operative elevator movement has encouraged many farmers in the belief that they can clean, dry, grade, and market grain at a lower cost per bushel than is now being paid for these services.

The community mill of our grandfathers' day, remodelled, and with the manufacturing process shortened, is again in operation at several places in Nebraska. In these communities the farmers are manufacturing their own flour, retaining the by-products for local sale, and effecting appreciable savings in transportation and handling.

Livestock furnish a home market for corn, hay, corn fodder, and other roughage. Only about 20 per cent of Nebraska's corn crop is shipped out of the county where it is grown. Livestock utilize roughage that would otherwise be wasted, provide profitable employment for the winter months, manufacture fertilizer, and with proper care, will usually pay a higher price for surplus corn and hay than can be obtained on any other market.

The Nebraska farmer is favorably situated for marketing livestock. Omaha, the gateway of the west, ranking second as a livestock market among all American cities, is at our eastern border. Kansas City, St. Joseph, Sioux City, and Denver also receive many carloads of stock during the year, from nearby portions of the state. The rapid growth of the Omaha livestock market attests not only its favorable location but also the high favor in which it is held by Nebraska stockmen.

Four factories provide a market for sugar beets. The farmer contracts his crop before the seed is planted or ground prepared. He takes a chance only upon yield. The price is assured. That the market for beets has been satisfactory is attested by the increasing acreage and

the tentative plans for erecting two more sugar factories. Such factories are built only where beets are produced.

The potato grower is the greatest optimist in Nebraska, and the most persistent risk taker among farmers. He plants his crop without the slightest information concerning the probable acreage in other sections, and can hazard only the most indefinite guess concerning yield and price. He can select his seed with care, treat it for fungus diseases, wage persistent warfare against weeds, and mayhap secure an enormous yield, but he cannot influence the production of potatoes in Wisconsin and Michigan, determine the productivity of war gardens nor guard against drouth and early frost. The crop must be marketed within a few months of the time when it is produced because potatoes are perishable and the American housewife prefers to buy immature potatoes from Texas to purchasing potatoes that have been six months in storage.

In spite of all, the potato grower has prospered and will doubtless continue to prosper. The Bureau of Markets is furnishing him information concerning the wholesale price of potatoes at various markets, so that selling is a little bit less of a leap in the dark than formerly. More information is obtained each year about acreage, yield, and probable consumption. Greater care given to grading the product is opening up a wider market. The southern demand for seed potatoes is increasing, and one potato flour mill has already begun operation to provide a market for culls. The elimination of unnecessary expense between producer and consumer will increase consumption, and provide a market for an increased production.

A large portion of our very best apples have usually been shipped outside of the state. There is a home market, however, that is large enough to consume at least the major portion of the crop. Better marketing methods will keep these apples in our state instead of our having to purchase apples from the far northwest.

The co-operative movement which has been successful among the grain growers is spreading among the livestock men, the potato producers and the orchardists. Its development will doubtless mean more systematic marketing, the elimination of considerable waste, and a preference for the home market.

THE TELEPHONE INDUSTRY

By R. E. MATTISON,
Of the Lincoln Telephone Company.

There are more than 250,000 telephones in Nebraska or one to a little less than five persons; 290 companies maintain exchanges and 70 or 80 rural lines are built, owned, and operated by farmers. Between $25,000,000 and $40,000,000 of capital is invested in the telephone business. The telephone industry is important because the network of wires with their universal connection serve to weld the state into an economic and social unit whose solidity would be otherwise impossible.

The Nebraska (Bell) Telephone Company, the pioneer company, is the largest. It operates about 88,000 telephones. The Lincoln Telephone and Telegraph Company operates close to 66,000 phones. Six other companies operate over 15,000 telephones. These are the Monroe, the Hamilton County, the Farmers of Dodge County, the Glenwood, the Kearney, the Platte County, the Southeast Nebraska, the Platte Valley, and the Wyoming and Nebraska companies. Dozens of companies operate several exchanges.

Of the 290 companies in the state, 218 are stock companies or mutuals which sell exchange service and are, therefore, required to make annual reports to the State Railway Commission and are under jurisdiction with respect to rates and service. The number under supervision is 230,000. To this number, at least 25,000 should be added to cover those connected with the mutual and switching lines.

The better quality of telephone apparatus now in use in the state has made possible the complete linking up of practically all exchanges by toll lines that do a tremendous yearly business, and which connect not only all Nebraska towns with each other, but give a nation-wide service to every phone user.

Rural Lines—Development of rural lines has been greater and the point of saturation nearer reached in some vicinities than in the cities. Many of the original lines built in 1900 were first made up of wires strung on fence posts or on two-by-fours nailed to the tops of fence posts. Most of these have disappeared and through co-operative effort in hauling poles, digging holes for them and helping put them in place, a much higher grade of rural service is given.

Duplicate Service—The duplication of service—meaning two exchanges in one city or town—has practically been abandoned in Nebraska. Some seven years ago a movement began to wipe out competing plants. The Nebraska Telephone Company sold a large number of its exchanges in its territory to the Lincoln Company, and sales were made by the Lincoln Company to the Nebraska Company of several important exchanges north of the Platte. This was followed by a

series of sales and readjustments until at the present time competitive exchanges exist at but a few points, Red Cloud, St. Edward, Hampton and Burwell.

This movement resulted in greatly bettering the character of the service, has permitted the installation of better equipment and modern instruments. War conditions caused the companies to ask for increased rates, which the commission has found necessary and granted in most cases, thus placing it upon a stable basis. The installation of a uniform system of accounting by the state commission, just made, is expected to greatly improve the financial conditions of the companies by giving them better knowledge of their operations.

History—The development of the telephone in Nebraska followed along the lines of national growth. Until the expiration in the late nineties of the basic patents of Bell, Berliner, and other pioneers, the business in Nebraska, as elsewhere, was under the complete control of the Bell interests. Several years thereafter, independent companies manufactured their own apparatus and entered the field.

EDUCATION IN NEBRASKA

EDUCATIONAL FACILITIES

By R. P. CRAWFORD,
Of the Nebraska Farmer.

Nebraska's educational facilities rank well with those of any state in the middle west. Over 7,000 schools offer an education to every boy and girl who desires it. Towns and cities have modern school buildings, while in the newer towns it is often the case that the finest building is the school.

The old fashioned one-room country schools with stove and water pail have given way to trim little buildings with furnaces, modern toilets, steel ceilings, slate blackboards—in every case comparing favorably with city school buildings. Along with these modern one-room buildings are the consolidated schools, big central buildings for a number of districts, with carry-alls or automobiles to take the students to and from school. In the last two years 54 of these consolidated schools have been established in the state, making a total of approximately 65 up to about May 1, 1919. Gage County in southern Nebraska now boasts the largest of these consolidated schools with 176 pupils and 8 automobiles to carry the students to and from school. Many carry-alls are in use for this same purpose over the state.

Schools Graded—The public schools include instruction from the kindergarten to and including the twelfth grade. Most country schools finish the eighth grade, yet some of them carry higher work as in the consolidated schools. Eighth-grade students are prepared to enter the high schools which are accredited at The University of Nebraska, and their graduates enter regularly upon college courses.

Equipment and Teachers—Nebraska's public schools are quite well equipped with libraries and appliances for laboratory and playground work. The teachers secured professional training at the Peru, Kearney, Wayne, and Chadron state normals, and at the State University. Teachers are paid wages above the average in most states. The school system is the pride of Nebraska. Every public school has a flag pole and the American Flag. Only American citizens are eligible to teach in these schools.

VOCATIONAL EDUCATION

By R. A. FULLMER,
Director of Vocational Education.

Vocational education prepares young people to make a living—to be self-supporting. Its aim is to educate, through both practical and theoretical instruction, with an eye to some definite purpose.

The Smith-Hughes Congressional Act, approved February 23, 1917, appropriated money for the promotion of vocational education in agriculture, home economics, and the trades and industries in high schools, and also the training of teachers in these lines. Nebraska met all conditions of this act for participation in the federal appropriations.

Under the Smith-Hughes plan a pupil is required to devote one-half of each school day to vocational and closely related subjects, but the other half of the day is given to the study of English, history, mathematics, and the like.

Agriculture—The course of study in vocational agriculture includes a thorough training in all forms of animal husbandry, soils and crops, wood and iron work, farm machinery including motors, tractors, etc., and farm management including marketing, rural economics and sociology.

Then each pupil must carry on a "home project" of importance under the direction of the teacher and in cooperation with the father. The plan is to interest the boy in the farm and not wean him away from it. The courses in agriculture range from two to four years.

Home Economics—The courses in home economics aim to prepare girls for the work of homemaking and homekeeping. The courses include all forms of sewing, garment making, designing, food study, cooking, serving of meals, home nursing, personal and home hygiene, etc. One-half of each school day is given to home economics instruction and the other half to regular academic subjects. Evening and part-time classes in home economics are provided for girls working in shops, stores, offices, and manufacturing places.

Trades and Industries—Although Nebraska is not a leading state in trades, and industries, evening and part-time classes in trade and industrial education are organized in connection with shops, offices, and manufacturing plants, in which instruction supplementary to daily employment or in preparation for better citizenship is offered.

Approved Schools—The number of approved schools for the year 1918-19 has been limited by the size of the appropriations, the scarcity of qualified teachers and by lack of time for organization. Next year the federal and state appropriations will be larger, more teachers will be available and more schools operated under the plan.

The following schools are now maintaining vocational agricultural

courses Blair high school; Bratton-Union consolidated school; Humboldt; Franklin high slhool; Hastings high school; Kimball County high school; Nehawka consolidated district; Union Center consolidated school, Liberty; and the Scottsbluff high school. The Alvo consolidated school and the Hooker County high school at Mullen are offering home economics courses. The Omaha high school of commerce maintains courses in carpentry, printing, mechanical, and auto mechanics, while The University of Nebraska offers courses in teachers training under the plan.

War Training Classes—In 1918 short courses for conscripted men were organized in various schools. During the half-year ending June 30, 1918, 455 men were given training in radio-buzzer, auto-mechanics, drafting, electricity, etc., certificated and most of them inducted into army service. Over 300 other men were in training when the war closed.

Disposal of Funds—Federal and state funds may be used only as a reimbursement to school districts for salaries paid to teachers of vocational subjects. The schools must provide all supplies and equipment. In Nebraska a school district is reimbursed for three-fourths of the salary of a teacher one-half from federal funds and one-fourth from the state funds while the district pays only one-fourth of such salary.

THE UNIVERSITY OF NEBRASKA

By R. P. CRAWFORD,
Of the Nebraska Farmer.

Activities—The University of Nebraska is closely connected with all the people of the state. Every graduate from a public high school has pursued courses outlined and recommended for those schools by the State University. Every farmer follows plans and crop systems that in many cases were first advocated and brought to public notice through the activities of the Agricultural College and the Agricultural Experiment Station. There is hardly a person in the state who has not become familiar with some department closely affiliated with the University proper, such as the Extension Service, Conservation and Soil Survey, or Legislative Reference Bureau. The institution's graduates are in every community, carrying out the work for which they received inspiration and training.

Age and Growth—The fifteenth of February, 1919, marked just fifty years of progress for the institution. That the dreams of the founders of the University have been more than realized is evident from the fact that the city campus—at one time believed ample for any possible development—long ago was outgrown and six more blocks of land have been added to keep pace with the increasing development.

Although the University was organized only 50 years ago it now occupies three campuses. The principal part of the University is on the city campus at Lincoln where there are 18 large buildings. The Agricultural College, on another campus at the edge of Lincoln has about 10 principal buildings, and adequate space for experimental work. The Medical College is at Omaha.

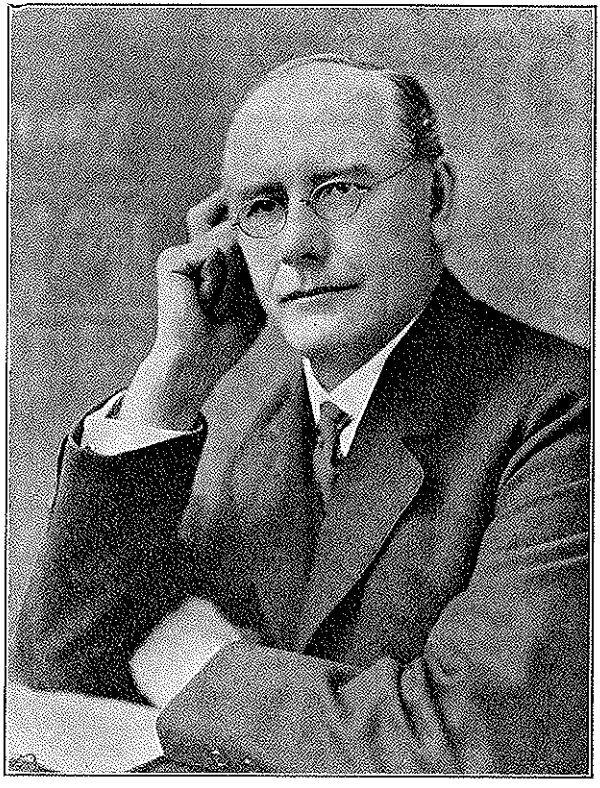


Figure 19. Dr. Samuel Avery, Chancellor of The University of Nebraska.

Students and Graduates—The graduates of the University now number nearly 7,000. It is safe to say that there is not a state in the Union and not a continent on the globe that does not have its quota. They can be found in practically every line of work and holding their own with graduates of other institutions.

It is entirely possible to point to almost any number of students whose incomes a few years after graduation are far beyond their ex-

pectations upon entering the institution. Many of them in the additional money earned three years after graduation have more than paid for their entire college course over what they were earning as a result of only a high school education. The University certainly would not have one believe that the object of its system is to enable men and women to enjoy larger incomes, but it does believe that the "new education" must look toward making its graduates a little more comfortable in a financial way.

University Education—If one, however, were to make up a statement of just what the University does for each student, it probably would be something like this: Give him an opportunity to make a better living than without an education, give him an opportunity to rub elbows with his fellows and to form a measure of his own capabilities, give him a little better appreciation of life's problems.

The University also appreciates the fact that those who enter its doors represent only a small number compared with those who can not. For this reason the University has brought education to the people. Through its regular Extension Department with its dozens of practical university courses offered by correspondence, and through its Agricultural Extension Service, as well as the educational work of the Conservation and Soil Survey, the institution has brought to thousands of people in the state at least some of the material benefits of a higher education.

To give a vivid outline of the resources of the institution would perhaps be almost impossible. To most people, probably, the University means a group of buildings near the heart of Lincoln. But to others it means an Agricultural College near the outskirts of the city, or a Medical College in the city of Omaha. People in western Nebraska may connect it most forcibly with the Curtis School of Agriculture, or the North Platte, Valentine, or Scottsbluff Substation. The horticultural interests of the state may think of a model fruit farm near Union. Or to some people the University may mean a Farmers' Institute or short course. The University is responsible for all of these varied lines of educational work. Financially speaking, the total value of the institution's holdings is now well above six million dollars.

New Buildings—During the past four years additional money has been made available for buildings. On the city campus of the University at Lincoln four new buildings have now been completed—a Chemistry Building, Bessey Hall—housing the botanical and zoological departments—Teachers' College High School, and a building for the social sciences. On the farm campus there are two new buildings—a Dairy and an Agricultural Engineering. At the College of Medicine at Omaha a hospital building has just been erected. Within the next two years most of the newly acquired property adjacent to the city campus at Lincoln will be cleared of the frame dwellings and made an integral

part of the University. The University's building program will compare favorably with that of any similar institution in the country.

Colleges—It is possible to say that the student attending The University of Nebraska may study almost any subject in which he may be interested and with fees probably smaller than at almost any similar institution. The University proper is divided into ten colleges: Agriculture, Arts and Sciences, Business Administration, Dentistry, Engineering, Graduate, Law, Medicine, Pharmacy, Teachers. The University also has the schools of Agriculture, Fine Arts, and the Teachers' College High School.

Fees—One of the policies of The University of Nebraska is to make its fees and charges as small as possible, believing that excessive tuition charges might deter students from entering. Several years ago the regents abolished even the special fee charged students from other states. At the present time a matriculation fee of $5 is charged every student entering upon work in the University. This is paid only once unless the student changes colleges. In the College of Arts and Sciences there are only the incidental fee of $3 a semester, laboratory fees of a few dollars, and a library fee of $1. It will be seen that students not taking laboratory work may pursue an entire semester's work upon payment of $4. Of course, in the more specialized lines of work such as law or medicine, there are larger fees, but in most cases smaller than elsewhere. That this has been a popular policy is evident from the fact that now the average yearly attendence in all its schools and departments is normally more than 6,000.

Experiment Stations and Agricultural Extension—What is known as the Agricultural Experiment Station is closely allied with the College of Agriculture and the Agricultural Extension Service. In fact all three of these branches have their headquarters at the University Farm. The College of Agriculture carries on the actual teaching of agriculture. The Experiment Stations are responsible for the experimental work in agriculture, while the Agricultural Extension Service conducts educational work in agriculture throughout the state. In most cases the workers affiliated with the Experiment Station also teach classes in the College of Agriculture.

The main farm at the Agricultural College, comprising 320 acres near the outskirts of Lincoln, is maintained for experimental purposes. Much of it is laid in plats where various crops and methods are tried from year to year. Another experiment station is located at North Platte, with a tract of 1,920 acres, and gives its attention to farming problems arising in that section. The substation at Valentine concerns itself especially with problems in the sandhills, while the Scottsbluff Substation takes up irrigation problems. Recently another farm, comprising 160 acres near the city of Lincoln, was purchased, and an experimental fruit farm of 80 acres has just been established near

Union. An orchard of forty acres has been planted on the latter tract and it will be developed into a model fruit farm for this district.

The Agricultural Extension Service probably has the largest number of workers and employes of any of the University departments. It also includes the home economics extension work and the junior extension work. During the war this activity developed rapidly and workers were placed on the road to carry the gospel of saving food. Closely allied with this work is the county agent movement, the county agents also being connected with the extension service.

Conservation and Soil Survey—The State Conservation and Soil Survey is another branch of activity that is especially related to the people of the state. It makes special studies of the soil, water, potash, forest, and road materials, and serves as an information bureau regarding the state's resources and industrial development. Soil reports and other bulletins are issued from time to time. This department has been responsible for the expose of many unworthy real estate schemes in which outside companies have endeavored to interest the people of Nebraska.

The Conservation and Soil Survey also has in charge the publicity and motion picture work of the state. Motion pictures have been made available for general use on practically every industry of importance as well as other subjects connected with the development of the state.

Finances—With such widely divergent activities, it might seem that the expense of The University of Nebraska to the taxpayers of the state would be unusually heavy. Such, however, is not the case. The total money expended through the University during the last two years for all expenses, aside from the new buildings was a little more than $2,985,000. But out of this amount the state itself pays only a little more than one-half. About $825,000 is derived by the University every two years from its tuition fees, income from farms, and sales of hog cholera serum, about $361,000 is derived from the federal government every two years. This means that the actual expenses to the taxpayers of running the institution is approximately $900,000 a year for maintenance.

War Work—In its war work the University maintained a record equalled by few institutions in the country. In percentage of enlistments it stood fourth among the universities of the country. General Pershing was a former commandant at the institution. When war was declared, more than 1,000 young men withdrew from the college and enlisted in the Army, Navy, or industrial work. Numerous members of the faculty were released for war service. In fact, the University placed its entire plant at the disposal of the government. In July, 1918, a National Army Training School was established, which with only a few exceptions handled more men than any school in a

similar institution. In the fall a Student's Army Training Corps was established with a membership of nearly 1,800 men. The College of Medicine organized Base Hospital No. 49, which served overseas, its personnel being made up of University men and women. At the close of the war the total number of students, former students, alumni, and employes enlisted in either Army or Navy was approximately 2,500, as far as complete records could be secured.

Summarizing, it may be said that the University is in close touch with and a factor in the Educational, Research, Survey, Industrial, Experimental, and Welfare work of Nebraska and that its benefits are felt in practically every home in the state.

THE STATE FAIR

By R. P. CRAWFORD,
Of the Nebraska Farmer.

Purpose and Attendance—The fair is the big educational and industrial show of Nebraska, held each September in the Capital city. Thousands of people make the state fair week their annual vacation. The total attendance at the fair in 1918 was 214,000, with a total of 65,000 people on a single day. In 1916 the total attendance was 193,176, and in 1917, 200,543. The special purpose of the fair, of course, is to display the resources and agricultural and industrial achievements of the state, besides furnishing a liberal amount of entertainment for the visitors.

Attractions—No matter in what line a person may be interested, there is something for him at the State Fair. The farmer naturally comes in for the biggest share of attention. He will find most attraction in the new hog, sheep, poultry, dairy, horse, and cattle barns, or in one of the many machinery buildings. For the mothers, there are the Better Babies contest, food demonstrations, and the like. The business man finds the manufacturer's building of interest, while for just the ordinary individual there are a hundred and one amusements, concerts, and similar entertainment to be found wherever fairs are held.

The stock parades show the hundreds of horses, cattle, and other animals. The farm products exhibits occupy a large part of Agricultural Hall. War exhibits, the boys' camp, domestic science demonstrations of various kinds, and the large displays of fireworks carried on at the race track are attractions.

Grounds and Buildings—The fair grounds, covering 183 acres, located at the north edge of Lincoln, are reached by three railroads, street cars, and paved street for traffic. A race track, grand stand, and horse barns occupy the north part of the grounds. There is a building for practically every purpose, including an automobile hall, auditorium,

coliseum, and state university building, manufacturers' building, an agricultural hall, and quarters for the dairy, bee, fish, and poultry departments. The coliseum, hog barn, and agricultural hall are rated among the best in the United States.

The fair grounds, of course, belong to the state, and upon these lands are placed improvements amounting to approximately three-quarter million dollars. Of this amount, the legislatures from 1901 to 1917 have appropriated $328,500, while receipts from the Fair have paid out over $436,000 in premiums in the same length of time, besides placing permanent improvements upon the grounds to the amount of $252,867, and have furnished labor and repairs to the amount of $265,570. Thus, while the state fair of Nebraska has been a worth while institution, it has, as well, been a paying institution to the state from a financial standpoint.

County Fairs—There are about fifty county fairs in Nebraska, with an attendance for 1918 of about 500,000 people. These fairs have property valued at more than $350,000.

SOME NEBRASKA FACTS

By G. E. CONDRA,
Director, Conservation and Soil Survey.

Nebraska, the "Cornhusker State," is near the center of the United States.
The area of the state, about 77,510 square miles, is greater than the New England states.
Cherry County is larger than either Rhode Island or Connecticut.
The width of Nebraska is between 207 and 208 miles.
The extreme length, east and west between meridians, is 465 miles.
The extreme distance in the state, from northwest to southeast, is about 500 miles.
The state slopes eastward and southeastward from an elevation of 5,340 feet to 840 feet above sea level.
The annual rainfall decreases from 33 inches in the southeast to 16 inches in the northwest.
The average rainfall for the state as a whole is 23.64 inches.
The average temperature is 48.6 degrees F.
The growing season decreasing from 160 days in the southeast to 130 days in the northwest.

There are 93 counties in Nebraska.
The eastern and southeastern parts of the state are beautiful farming areas.
The Sandhill Region is a great cattle raising country.
The western parts of the state support grazing, dry farming, and irrigation.

Nebraska has 34 distinct layers of stone and large deposits of volcanic ash, building sand, and clay.
Sand is shipped from Nebraska to Iowa, Kansas and Missouri.
There is no coal of importance in Nebraska.
There is a large modern cement plant at Superior.
The state has 67 water powers and more than 1000 artesian wells.
The state has a good water supply and a healthful climate.
Nebraska ranks first in potash production in the United States.
Antioch, Nebraska, is the largest potash center in the United States.

Between three and four per cent of Nebraska is forested.
Nebraska is the home of Arbor Day.
Ducks, coots, and shore birds nest in and about the sandhill lakes.
Fishing and hunting are quite good in Nebraska.

The state has three fish hatcheries located northeast of South Bend, northeast of Valentine, and near Benkelman.

There are 427 species of birds, 100 species of mammals, 65 kinds of native trees, and about 200 kinds of grasses and sedges in Nebraska.

Nebraska has more than 100 kinds of soil.

There are no public lands subject to entry in Nebraska, except a few remnants, which are undesirable small tracts.

The days of cowboys and open ranges have passed. The land is owned, fenced, and successfully farmed.

According to this year's report of the State Department of Agriculture there are 119,333 farms in Nebraska, 16,397,917 acres of which are cultivated, and 29,655,404 are used for pasture, wild hay, and other purposes.

Nebraska soils are productive without the use of artificial fertilizers. They contain plant food materials in desirable proportions, except humus which is relatively low in some types and can be supplied or replenished by growing legumes.

Irrigation has importance in western Nebraska.

More than 300,000 acres of Nebraska are irrigated from canals, and a considerable amount is irrigated from wells.

About 125,000,000 pounds of beet sugar are produced annually in Nebraska.

Apple growing has commercial importance in the southeastern counties.

The state has high rank in the production of corn, wheat, alfalfa, oats, potatoes, poultry, hogs, beef cattle, and dairy products.

The crop yields in Nebraska average higher per acre than in the United States as a whole.

The annual values of some of the leading crops grown in Nebraska, averaged for the years 1918 and 1919, are as follows: Corn, $194,050,885; alfalfa hay, $63,741,922; wheat, $54,079,780.00; wild hay, $44,446,034.00; oats, $38,956,854.00; sorghum and kafir, $9,000,000; potatoes, $8,502,183.00; rye and barley, $5,611,636.00; sugar beets, $6,000,000.00.

Nebraska is a leading state in beef production because of the extensive grass lands, affording pasturage and hay; the healthful climate and comparatively dry underfooting for animals; the abundance of good water; large supplies of fattening feeds; good transportation facilities; and the presence at Omaha of large stock yards and packing houses.

During a 20-year period ending in 1915, Nebraska ranked third among the states in corn and wheat production and fourth in oats.

Nebraska produces more beef per capita than any other state.

Many thousands of sheep from Wyoming, Montana, and other western states are finished for market in Nebraska on our alfalfa, beet tops, beet pulp and grains.

The state has two of the world's largest horse markets, at Grand Island and Omaha.

Nebraska leads in the per capita production of agricultural products.

The leading kinds of livestock in 1918 were valued as follows: cattle, $213,943,510.00; horses, $81,907,110.00; hogs, $61,147,080.00; mules, $10,219,200.00.

Nebraska produced 10,497,998 bushels of potatoes in 1918. Among the leading counties in potato-growing are Scotts Bluff, Box Butte, Sioux, Sheridan, Morrill, Dawes, Brown, and Cherry.

There are about 2,000,000 apple trees and 250,000 cherry trees of bearing age in Nebraska.

Floriculture has commercial importance in Lincoln and other cities in Nebraska.

Agricultural products of Nebraska for 1918 were valued at about $1,000,000,000.00.

The manufactured products of Nebraska factories have an annual value of about $500,000,000.00.

One of the largest ore smelting and refining plants in the United States is at Omaha.

Automobiles, trucks, and auto accessories are manufactured at Omaha and Lincoln.

The Hebb Motor Company of Lincoln is one of the leading truck manufacturing companies in the United States.

Gas engines, made in Lincoln by the Cushman Motor Works, are shipped to all parts of the world.

Aeroplanes are manufactured at Lincoln and shipped throughout the United States.

The M. C. Peters Mill Company of Omaha is the largest manufacturer of alfalfa feeds in the United States.

The Charles C. Smith Company of Exeter is thought to be the leading manufacturer of indexed tags in the United States.

The Dempster Mill Manufacturing Company of Beatrice is one of the largest producers of windmills, pumps, and farm machinery in the country.

The M. M. Johnson Incubator Company of Clay Center, Nebraska, is said to be the largest manufacturer of incubators in the United States.

The Deshler Broom Factory of Deshler, Nebraska, has the largest single broom manufacturing plant in the United States.

The Lee Broom Manufacturing Company, with general offices and factory at Lincoln and branch plants at Davenport, Iowa, and Boston, Massachusetts, is the largest broom manufacturer in the United States.

The Skinner Macaroni Company of Omaha is said to be the largest manufacturer of macaroni in the United States.

The state has four beet sugar factories located at Grand Island, Scottsbluff, Gering and Bayard, and the fifth is building at Mitchell.

Nebraska has 36 successful brick manufacturing plants which manufactured 122,000,000 brick and tile (brick measure) in 1919.

There are 7,242 miles of railway line in Nebraska.

There are more telephones in Nebraska than in Great Britain.

Cooperating with the federal government, Nebraska has an extensive plan for permanent road building.

Grand Island, Hastings, Fremont, Beatrice, York, Kearney, Nebraska City, Norfolk, Columbus, North Platte, Scottsbluff, Alliance, Falls City, McCook, and Chadron are among the largest growing cities of Nebraska.

Most Nebraska cities have wide paved streets, parks, public water supplies, electric lighting, modern schools, public libraries, commercial clubs, and welfare organizations.

Omaha, the metropolis, has a population of about 200,000. It is thirty-third in population and sixteenth in business in the United States. The city has 170 miles of street railway, 489 wholesale and distributing houses, more than 500 factories, and is the third largest live-stock center in the world. It is the world's largest butter-making center and one of the world's largest meat-packing centers.

Ak-Sar-Ben (the name "Nebraska" spelled backwards) is widely known through its initiations and carnivals. It is to Omaha and the Central West what the Mardi Gras is to New Orleans and the South.

Lincoln, the capital city, has a population of about 80,000, including the suburbs. It is the seat of several state institutions, including The University of Nebraska. Lincoln is an important educational, manufacturing, retail, jobbing, and railroad center.

Lincoln has the home offices of several insurance companies.

Nebraska has a well organized school system, headed by a great University of more than 6,000 students.

Vocational education is emphasized in Nebraska.

There are four state normal schools and a number of successful denominational colleges in Nebraska.

The permanent school fund of Nebraska has about ten million dollars invested in interest-bearing securities.

The state is well served with newspapers and publishing houses. A number of magazines and books are published in Nebraska.

Nebraska has one of the largest state fairs in the United States.

Nebraska divides the honor with one other state in having the lowest per cent of illiteracy.

Social conditions are of a high order in Nebraska.

The death rate is low in Nebraska.

The population of Nebraska is about 1,300,000.

Nebraska has no bonded indebtedness.

Much of Nebraska has been surveyed as to its resources and industries, and information, principally in the form of bulletins, is available upon request from the Conservation and Soil Survey Department at The University of Nebraska, Lincoln. This department will issue an industrial bulletin each year in the future, outlining the development of the state's resources and publishing statistical matter thereon.

INDEX